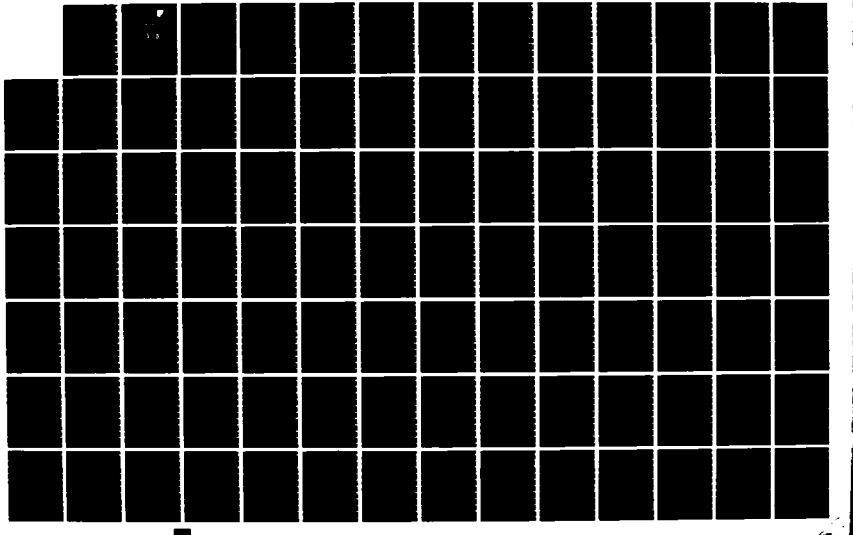
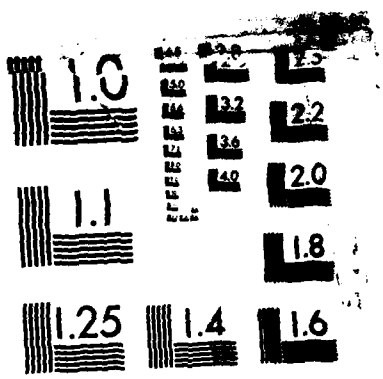
AD-A168 344 SURVEY OF MODELS/SIMULATIONS AT RADC (ROME AIR DEVELOPMENT CENTER) VOLUME 3(U) ROME AIR DEVELOPMENT CENTER GRIFFISS AFB NY M L DENZ MAR 86 RADC-TR-86-9 1/2

UNCLASSIFIED F/G 17/2 NL





(12)

RADC-TR-86-9
In-House Report
March 1986

SURVEY OF MODELS/SIMULATIONS AT RADC

Mary L. Denz

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

ROME AIR DEVELOPMENT CENTER
Air Force Systems Command
Griffiss Air Force Base, NY 13441-5700

This report has been reviewed by the RADC Public Affairs Office (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be releasable to the general public, including foreign nations.

RADC-TR-86-9 has been reviewed and is approved for publication.

APPROVED: Ronald Raposo

RONALD S. RAPOSO
Chief, C^2 Systems Technology Branch
Command and Control Division

APPROVED: Gerald D. Long

GERALD D. LONG, Colonel, USAF
Chief, Command & Control Division

FOR THE COMMANDER: Richard W. Pouliot

RICHARD W. POULIOT
Plans & Programs Division

DESTRUCTION NOTICE - For classified documents, follow the procedures in DOD 5200.22-M, Industrial Security Manual, Section II-19 or DOD 5200.1-R, Information Security Program Regulation, Chapter IX. For unclassified, limited documents, destroy by any method that will prevent disclosure of contents or reconstruction of the document.

If your address has changed or if you wish to be removed from the RADC mailing list, or if the addressee is no longer employed by your organization, please notify RADC (COTD) Griffiss AFB NY 13441-5700. This will assist us in maintaining a current mailing list.

Do not return copies of this report unless contractual obligations or notices on a specific document requires that it be returned.

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

AD-A168344

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS N/A
2a. SECURITY CLASSIFICATION AUTHORITY N/A	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) RADC-TR-86-9	5. MONITORING ORGANIZATION REPORT NUMBER(S) N/A
6a. NAME OF PERFORMING ORGANIZATION Rome Air Development Center 6b. OFFICE SYMBOL (If applicable) COTD	7a. NAME OF MONITORING ORGANIZATION N/A
6c. ADDRESS (City, State, and ZIP Code) Griffiss AFB NY 13441-5700	7b. ADDRESS (City, State, and ZIP Code) N/A
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Rome Air Development Center 8b. OFFICE SYMBOL (If applicable) COTD	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER N/A
8c. ADDRESS (City, State, and ZIP Code) Griffiss AFB NY 13441-5700	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 62702F; PROJECT NO. 5581; TASK NO. 28; WORK UNIT ACCESSION NO. 04

11. TITLE (Include Security Classification)
SURVEY OF MODELS/SIMULATION AT RADC (Volume III)

12. PERSONAL AUTHOR(S)
Mary L. Denz

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
In-House	FROM Jul 85 TO Jan 86	March 1986	120

16. SUPPLEMENTARY NOTATION Volumes I and II of this report were previously printed as RADC-TM-82-7 dated November 1982 and RADC-TM-82-7 dated December 1983.

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Command, Control, Communications, and Intelligence Local Area Network Model/Simulation
09	02	17	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

A survey was conducted to evaluate the current state-of-the-art and technology of model/simulation capabilities at RADC, Griffiss AFB NY and Hanscom AFB, MA. This report presents a tabulation of 60 such models/simulations. These models/simulations are being used within RADC in the development and evaluation of Command, Control, Communications, and Intelligence (C^3I) Technology. The results of this survey are incorporated in this report.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Mary L. Denz	22b. TELEPHONE (Include Area Code) (315) 330-3623 22c. OFFICE SYMBOL RADC (COTD)

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

Technical Report

SUBJECT: Survey of Models/Simulations at RADC.

A survey was conducted to evaluate the current state of the art and technology of model/simulation capabilities at RADC, Griffiss AFB and Hanscom AFB. This report presents a tabulation of sixty (60) such models/simulations. These models/ simulations are being used within RADC in the development and evaluation of Command, Control, Communications and Intelligence (C3I) technology. The results of this survey are incorporated in this memo.

ABSTRACT

The third volume of the SURVEY OF MODELS/SIMULATIONS AT RADC lists the descriptions of models/simulations in general use throughout RADC, Griffiss AFB and Hanscom AFB. The entries in this catalog are listed alphabetically by acronym followed by its long title. The description of each model includes: title, developer, status, purpose, general description, input, output, model limitations, hardware, software, operation, security classification (of the model less data) and point of contact (for additional information).

FOREWORD

This catalog documents the response received from RADC, Griffiss AFB and Hanscom AFB. In assembling this catalog I have asked developers of previous volumes to update their past entries and submit new entries. Response has been overwhelming and everyone's participation is appreciated.

Publication of a catalog such as this involves the support of many individuals. I would first like to express my appreciation to Robert F. Flo for his help in the preparation of this TR. I would like to thank each of the contributors individually. Unfortunately, this is not possible. Publication of your entry is acknowledgement of my appreciation.

Mary L. Denz

Mary L. Denz
Distributed Systems Section
Command and Control Systems Technology Branch

TABLE OF CONTENTS

SECTION I

INTRODUCTION

INTRODUCTION

This memo presents the results of a survey conducted by the Distributed Systems Section (COTD) to identify and document existing/planned models and simulations being used in the development and evaluation of Command, Control, Communication and Intelligence (C3I) technology at RADC, Griffiss AFB and Hanscom AFB. Resource integration/sharing will be facilitated by the Fiber Optic/Local Area Network Communications being implemented within the RADC complex at Griffiss AFB.

Background:

The RADC mission as an AF C3I Laboratory, is directed at the development and integration of collection, processing, exploitation, decision, communication and control technologies. Exploitation of existing and planned, physically separated laboratory resources and the integration of the functional elements they represent is to be achieved through an instrumental fiber optic and Local Area Network (Broadband Bus) communications capability to form a MULTINET--a communication system made up of networks. MULTINET consists of the two communication networks which tie together the major laboratories and offices of Buildings 240, 106, and 3 on Griffiss AFB into an Integrated C3I Laboratory environment. This unique idea will provide RADC with the capability for a total system approach to development, test, and evaluation of C3I systems. The major objectives of the Integrated C3I Laboratory are:

- Demonstrate, validate and test proposed concepts, systems and subsystems, equipments and interfaces under a common C3I threat environment.
- Provide user/developer interaction and hands-on experience with concepts and capabilities.
- Facilitate transfer of technologies into operational environments.

The Integrated C3I Laboratory will integrate the models, simulations and databases of the intelligence labs in Building 240, the surveillance lab in Building 106 and the Communications, Command and Control, and Reliability and Compatibility capabilities in Building 3, into a common C3I threat environment to demonstrate and evaluate RADC's R&D products. To accomplish the above, the program has been structured to encompass the following efforts:

a. Fiber Optic Network: RADC installed a fiber optics communications network between Buildings 3, 106, and 240 at Griffiss AFB. The Fiber Optic network is used for wideband trunking between buildings and provides point-to-point communications for high and ultra high bandwidth users (greater than 1 Mbit).

b. Battle Management Laboratory: A Battle Management Laboratory was constructed to allow for simulating, testing, evaluating, and demonstrating C3I concepts, designs, hardware and software. The BML will contain a computer complex capable of running major, interactive, real-time simulation programs. The same complex will be used for data reduction and analysis. The BML design allows for maximum reconfigurability to emulate a variety of Command and Control nodes. The BML nodes will serve as the central node of the integrated

Control nodes. The BML nodes will serve as the central node of the integrated capability and also act as a gateway for communication to external DOD sites. The BML will allow users from operational commands to interact with design engineers in all stages of system design and development.

c. Local Area Network (LAN) Implementation: The term Local Area Network refers to a communication distribution (BUS) system, which is used to facilitate connectivity among various users and devices (computers and terminals) within the Integrated C3I Laboratory. A LAN has been installed in Buildings 3, 106, and 240 with the individual networks connected via fiber optic cable between buildings. The system consists of a fiber optic network for point to point high data rate communications, and a coax cable network, for multiple user shared resource communications. The coax cable network is a broadband dual cable system utilizing off-the-shelf standard cable television components for the distribution of data, video, and voice. The layout was designed by Mitre Corp. and installed by the 485EIG at Griffiss AFB. The network is capable of handling simultaneous user requirements for transmitting digital data and voice as well as television over a single broadband 300 MHz CATV Cable.

Scope of Survey:

The survey focused on the identification of the models/simulations used by RADC engineers in the development and evaluation of C3I technology concepts, designs and systems. At this point, no attempt was made to extend the survey beyond the RADC organization. Models/Simulations covered in the survey include communications, surveillance, and tactical C3.

Purpose of Survey:

The purpose of the survey was to update RADC-TM-82-7, SURVEY OF MODELS/SIMULATIONS AT RADC, Vol. II. This technical memo contained information on the use of models/simulations at RADC in the development of C3I technologies. Due to the overwhelming, Air Force wide response to RADC-TM-82-7, it was necessary to update it.

Survey Methodology:

A survey questionnaire (Appendix I) was developed to gather information from RADC engineers who were implementing or using a model/simulation. The questionnaire focused upon the identification of the models and simulations used by RADC engineers in the development and evaluation of C3I concepts, designs, and systems. Additional technical information regarding hardware/software operation, interface, limitations/assumptions, documentation and status was also solicited in an attempt to provide a brief but comprehensive description of the model/simulation. The Office of Primary Responsibility (OPR) for each model/simulation along with the responsible person and corresponding telephone numbers are provided if additional information is desired by the reader.

Scope and Content of Report:

Section II serves as a shortened version of the survey with important characteristics highlighted. Section III contains the model/simulation abstracts.

Terminology:

This section provides the reader with a general introduction into modeling and simulation as well as an aid in understanding the results of the survey.

Simulation:

Simulation consists of the construction of a state history of numerical results. A state history is a chronological succession of state descriptions, i.e., the state of the system at a specific instant of time. A simulation model is not a type of model, but merely a statement that the model is being used to produce a state history. The term computer simulation refers to the use of a digital computer to simulate the model. It does not mean a computer is being simulated.

Model:

For purposes of this survey, the term model will be limited to mean the symbolic representation of the system or subsystem being studied. In general, a model represents the most significant aspects of the system being studied. Models can be either analytical (mathematical) or numerical. Simulation models of mathematical expressions solvable by "hand" calculations or with the aid of a computer, are used extensively to evaluate computer communications systems and subsystems. Such models are precise because they consist of symbolic expressions. Numerical models operate on numerical values, not symbols, and use a brute force numerical approach that make solutions feasible only through the use of digital computers. Numerical models result in approximations that are only as precise as time and money will allow. Simulation models are numerical models as they are based on random event driven occurrences rather than on precise mathematical relationships.

Pure Models, Aggregate Models, and Wargaming Models:

Pure models are generally phenomenological models. They simulate a small piece of technology. These simulations are very fine in technological detail and should be left in the hands of the people with expertise in the phenomenology being modeled in order to keep the model accurate and up to date.

Aggregate models simulate technicalogical systems. They generally have less detail than the pure models. Models such as C3SAM (Command, Control, and Communications Systems Analysis Model) are aggregate-type models. Due to their lack of fine detail, aggregate models can be separated from the people with expertise in the subject, and so may be placed in a general purpose simulation library.

Wargaming models test technology and/or tactics against the backdrop of the battle field. Systems in a wargame are tested for effectiveness in a war time environment, as opposed to being tested for capability and efficiency.

Simulation Languages:

Special high-order language compilers have been developed for the implementation of simulation models. These compilers simplify the coding of models in the same way that general purpose compilers simplify the coding of other problems. Modeling languages are designed for the implementation of models, and hence have special features unique to modeling requirements. Some of the more commonly used simulation languages are SIMSCRIPT, GPSS, ECSS and GASP. SIMSCRIPT and ECSS have been used almost exclusively by the Federal Computer Performance Evaluation and Simulation Center (FEDSIM) in the implementation of models for ESD SPO's. FORTRAN, while not specifically designed as a simulation language, has been used extensively in the implementation of simulation models. It is also the basis of the GASP language.

SECTION II

INDEX OF MODELS

INDEX OF MODELS

Simulation/ Model Name	Page No	Application Area	Language + Machine	Operating System	Status
AASRSIM	17	Airborne Surveillance Radar Evaluation	FORTRAN Vax 11/780	VMS V4.1	OP
ANTFARM	19	Analyst Tool	BASIC Tek 4054A	N/A	OP
ASE	20	Sensor Correlation Analysis	FORTRAN VAX 11/780	VMS	OP
BRET	21	Sensor System Analysis	FORTRAN VAX 11/780	VMS	UM
BSG	23	C3CM Technique Analysis	PASCAL VAX 11/750	VMS	OP
C3I VOICE	25	Advanced Speech Processing Station	LISP To Be Det	To Be Determined	UD
C3 SAM	26	Functional Analysis of TACS	COBOL H8/44D	GCOS	OP
CS	27	Data Analysis and Modeling Capability	CS, JANUS Hon DPS 8	MULTICS	OP
DATOMUT	30	Ground Based Unattended Radars	FORTRAN CDC 6600	CDC 6600	OP
DDG	31	Airborne PAVE MOVER Radar	FORTRAN 77 VAX 11/780	VMS V4.1	OP
DGTS	32	Battlefield Scenario	PASCAL VAX 11/780	VMS	OP
DPGS	34	Digital Image Processing	FORTRAN PDP 11/70	RSX-11M	UD
DSS	36	Performance Analysis of Computer Networks	SIMSCRIPT VAX 11/780	VMS	OP
EHF/SHF	38	Radio Propagation	FORTRAN IV HI 6180	MULTICS	OP
FAP	39	Arch to Support ELINT Sim into ELINT Envir	FORTRAN Hon, DEC	GCOS, VMS, RSX-11M	OP

OP--> OPERATIONAL. UD--> UNDER DEVELOPEMENT. UM--> UNDERGOING MODIFICATIONS.

INDEX OF MODELS

Simulation/ Model Name	Page No	Application Area	Language + Machine	Operating System	Status
GEAP	41	ICBM Assessment	FORTRAN 77 VAX 11/780	VMS	OP
GEMACS	43	Electromagnetic Model	FORTRAN IV H6180	GCOS	Version 4 UV
GLS	45	Tactical Analysis	FORTRAN VAX 11/780	VMS	OP
GRASP	46	Radar System Performance	FORTRAN IV CYBER 750	Network Op Sys 2.3	OP
HF	48	HF Comm Equipment Design and Analysis	FOR/Assem PDP11/40-60	RSX 11-M Ver 3.1	OP
HYDRA	49	Battle Management Decision Aids	ROSS LMI Lambda	N/A	UD
ICAAM	50	Antenna Modeling Techniques	BASIC Tek 4054A	N/A	OP
ICNAS	51	Communication Network Performance Analysis	FORTRAN IV PDP 11/70	RSX-11M	OP
ICS	52	Communication Links/ Processing	FOR,Assem PDP11,VAX	RT-11,RSX 11-M,VMS	OP
ICSSM	54	Communication System Design and Analysis	FORTRAN H7/80,VAX	MULTICS VMS	OP
IEMCAP	56	Electromagnetic Compatability Analysis	FORTRAN IV Hon DPS 8	GCOS	OP
IIPL	58	Hardware Configuration for Simulation	FOR, COBOL PDP11,VAX	IAS, VMS	UD
IN	59	Switching Techniques Analysis	CAL Assem PE 8/32	OS32MT Rev. 5.2	OP
IRSS	60	Waveform Simulation	FORTRAN VAX 11/780	VMS Vers. V4.1	OP
ISAE	62	Rapid Prototyping Techniques	Prolog C VAX,DN550	VMS, AEGIS	UD

OP--> OPERATIONAL. UD--> UNDER DEVELOPEMENT. UV--> UNDER VALIDATION.

INDEX OF MODELS

Simulation/ Model Name	Page No	Application Area	Language + Machine	Operating System	Status
LOS ECM SIMULATOR	64	LOS Communication Design and Analysis	N/A	N/A	OP
LPC-10	66	Voice and Data Rate Communications	FORTRAN 77 PDP11/70-45	RSX-11M	OP
MAFIA	67	Analytical Tools	PASCAL Apple Lisa2	MACOS	UD
MODEC	68	Automated Design Synthesis on Rockets	FORTRAN 77 VAX 11/780	VMS	OP
NCAP	69	Frequency Domain Analysis of Elec Circuits	FORTRAN IV Hon DPS 8	GCOS	VA
NISA	71	Reliability of Microelectronic Devices	FORTRAN Hon 8/44D	GCOS 4JS3	OP
PAAS	72	Parametric Analysis of Antennas	FORTRAN VAX 11/780	GCOS	OP
QM-1	73	Microprocessor Analysis	Various Dec20,HDPS8	TOPS 20, MULTICS	OP
QPRIM QM-1	74	Emulation of Digital Computer Architectures	BLISS DEC 20	TOPS 20	OP
RADCLAM	75	Electromagnetic Signals	FORTRAN CDC6600,CYB	N/A	OP
RADC RCS	77	Radar System Performance	FORTRAN VAX 11/780	VMS 4.1	OP
RADSIM	78	Waveform Simulation	FORTRAN VAX 11/780	GCOS	OP
RAMP	79	Electronic Sys Rel, Main + Avail Analysis	FORTRAN IV	MULTICS DEC 20	ER
RNET	81	Tactical Sensor Networks Analysis	FORTRAN VAX 11/780	VMS	Not CurrentlyOP
RTD for FTS	82	Fault Tolerant Systems	N/A	N/A	TR

OP--> OPERATIONAL. UD--> UNDER DEVELOPEMENT. ER--> ONGOING EXPANSION and REVISION. TR--> TR DOCUMENTS STUDY RESULTS. VA--> VERIFIED and AVAILABLE.

INDEX OF MODELS

Simulation/ Model Name	Page No	Application Area	Language + Machine	Operating System	Status
SATCOM	83	Satellite Communication Architectures	FORTRAN VAX 11/780	MULTICS	OP
SATSIM	84	Satellite Communication Architectures	FORTRAN VAX 11/780	MULTICS	OP
SBRCOV	85	Detection Coverage of Targets from a SBR	FORTRAN VAX 11/780	VMS 3.3	OP
SEMRAD	86	Moving Target Detection Perform Analysis	FORTRAN 77 VAX 11/780	VMS	OP
SIM DRIVER	88	Technical C3I	VAX PASCAL VAX 11/780	VMS	OP
SKS	91	Speech Recognition	FORTRAN 77 PDP11/70-45	RSX-11M	OP
TAC CONTROLLER	92	Tactical Surveillance Systems Analysis	FORTRAN IV HI 6180	GCOS	OP
TACOM II	94	Tactical Comm System Effectiveness Analysis	FORTRAN IV HI 6180	MULTICS	OP
TASRAN II	96	Tactical Surveillance Sys Netting Analysis	FOR/CIFT VAX 11/780	VMS	OP
TELMOD	98	Ballistic/Aerodynamic Missile Modeling	FORTRAN VAX 11/780	VMS	OP
TRAFFIC SIMULATOR	99	Communications Traffic Loading Analysis	FOR, Assem PDP 11/44	RSX-11M	IT
TROPO ECM	101	Tropo Analysis within ECM Environment	N/A	N/A	OP
TROPOSCATTER CHANNEL SIM	103	Tropo Communication Design and Analysis	N/A	N/A	OP
UMOS	104	Orbital Simulation	BASIC Tek 4054	N/A	MF
WIDEBAND LOS SIM	105	LOS Modem Analysis	FOR, Assem PDP 11/40	RSX-11M	OP

OP--> OPERATIONAL. IT --> IN TEST. MF --> AVAIL. SEP 85 FOR MOST FUNCTIONS.

SECTION III

MODEL/SIMULATION ABSTRACTS

TITLE: AASR SIM - Advanced Airborne Surveillance Radar Simulation

DEVELOPER: RADC/OCTM

STATUS: Operational

PURPOSE: AASR simulation models are used to predict the radiation patterns of conformal arrays and to evaluate the performance of a moving radar platform system for detecting air-vehicle targets in clutter. A space-based case is supported by orbit dynamics and rotating earth cases as an explicitly selectable option. Stationary platform radar is supported as a special degenerate case.

GENERAL DESCRIPTION: AASR is a surveillance simulation to evaluate certain aspects of airborne surveillance radar. In particular, modes developed are used to predict radiation patterns of conformal arrays, spectra of clutter after signal processing and aspects of detection and tracking such as ambiguity removal, constant-false-alarm-rate processing, etc. AASR simulation execution may begin at several locations, depending on the intent of the analysis. Initially the analysts may begin at Conformal Array Pattern Simulation (CAPSIM), computing antenna patterns for arrays on nonplanar surfaces using selectable element types, dispositions, illuminations, error models and output data sets. Results of CAPSIM or from other simulation sources; i.e., Parametric Antenna Analysis System (PAAS) or Space Antenna Frequency (SARF) Simulation can be used as the input file of antenna patterns for Airborne Moving Platform Simulation (AMPSIM) : Stage 1, which will process these spacial parameters, along with environmental parameters (radar-cross-section, atmospherics absorbtions, etc...) to produce appropriate descriptions of targets, clutter and jammers in terms of intensity, time and frequency. AMPSIM : Stage 2 acts upon the results of Stage 1, adding the effects of the radar waveform and signal processing to compute range/doppler/intensity descriptions of targets, clutter, jammers and noise. The last primary simulation, Fast Running Main Beam Only (FRMBO), calculates signal-to-noise ratio, clutter-to-noise ratio, two-way antenna gain and minimum discernable velocity as functions of target range, azimuth and range rate of total clutter power as a function of beam depression angle. The analyst inputs all target, radar, clutter, waveform and signal processing parameters interactively, or they can be read in from a saved disk file. The simulation is rounded out by support software (plotting packages, mapping package, geometrical set-up aid package and a file translation package) to assist in problem definition and output data analyses.

INPUT: Function of problem complexity and depth of simulation to be performed. Input required includes radar system data, antenna specification data, scenario definition data, target specification data, waveform data, etc...

OUTPUT: Function of problem being simulated and analysis desired. Output possible includes plot of the positions of the antenna elements in the aircraft coordinate system, plot of the target and jammer positions and velocities in the radar coordinate system as ground range and azimuthal angle from the radar, plots of clutter radar cross section (RCS) density, clutter range/ doppler, sine space, etc. A scenario plot is available along with data printouts.

MODEL LIMITATIONS:

1. Maximum of 20 targets and 20 jammers can be selected for consideration in AMPSIM : Stage 1.
2. No computation of detection probability for target fluctuation models.
3. No plot capability for coverage contours detection probabilities.
4. With optional notch filter, user is limited to a third order feedback cancellor.
5. Displaced-phase-center antenna effects simulated are valid only when antenna is oriented in an optimal or near-optimal manner.
6. No multipath and/or diffraction effect in the AMPSIM and FRMBO models.

HARDWARE:

TYPE OF COMPUTER : VAX 11/780
OPERATING SYSTEM : VAX/VMS Version V4.1
MINIMUM STORAGE : 20K blocks
PERIPHERALS : Tek 4014 Graphics Display Unit, Tek 4631 Hard Copy Unit Tek 4107 Computer Display Terminal, Tek 4695 Color Graphics Copier.

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN-VAX-11 FORTRAN, based on American National Standard FORTRAN-'77 (ANSI X3.9-1978).
DOCUMENTATION IDENTIFICATION : Final Technical Report (Two Volumes), Program Maintenance Manual (7 Volumes), User's Manual.

OPERATION: Batch or Interactive Modes

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/OCTM
Mr. Stan Borek
Griffiss AFB, NY 13441-5700

AV 587-4433, COM: 315-330-4433

TITLE: ANTFARM - Antenna Formulation and Requirements Model

DEVELOPER: RADC/IRAE

STATUS: Operational

PURPOSE: The purpose of ANTFARM is to aid the antenna analyst in producing the input cards to GEMACS (General Electromagnetic Model for the Analysis of Complex Systems).

GENERAL DESCRIPTION: ANTFARM produces the input cards to GEMACS by allowing the used to simply draw a picture of the antenna to be modeled using a computer graphics terminal.

INPUT: General description of antenna configuration

OUTPUT: Computer print out of input job stream to GEMACS

MODEL LIMITATIONS: N/A

HARDWARE:
- Tektronix 4054A graphics terminal
- 64K internal RAM
- Two floppy disk drives (Tektronix 4907)

SOFTWARE:
PROGRAMMING LANGUAGE : Plot 50 BASIC
DOCUMENTATION IDENTIFICATION : Software Documentation and User's Manual under development

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/IRAE
Lt. Steven D. Farr
Griffiss AFB, NY 13441-5700

AV 587-7151, COM: 315-330-7151

TITLE: ASE - Advanced Sensor Exploitation

DEVELOPER: RADC/IRRP: PAR Technology

STATUS: ASE is running in a research and development environment and is fully demonstratable. Work is on-going to expand correlation/fusion techniques.

PURPOSE: To develop the capability for automated multi-sensor data correlation and subsequent analysis of correlated data. The laboratory configuration with the Dynamic Ground Target Simulator (DGTS) and the Sensor Simulators make ASE a general purpose system with applications in training, sensor capability analysis, target analysis, situation analysis and wargaming analysis.

GENERAL DESCRIPTION: ASE is a near-real-time (NRT) multi-sensor exploitation center. It receives NRT sensor target reports and intelligence data, and from these it generates, maintains and exploits a dynamic order of battle. The dynamic order of battle reflects the current ground situation as perceived by ASE.

INPUT: Presently includes sensor and HUMINT messages including MTI (i.e., Joint STARS), radio/radar detection/location (i.e., PLSS, ELS), and Imagery (ASTARS). Although in ASE specific message formats, inputs could expand to other sensor information.

OUTPUT: Some hardcopy on file contents is available, most output is on the RAMTEK graphics display with on-line interface to a VT-100 to provide statistical data and assist with operator interaction.

MODEL LIMITATIONS: Operation is dependent on available digitized cartographic data base(s).

HARDWARE:

TYPE OF COMPUTER	:	VAX 11/780
OPERATING SYSTEM	:	VMS
MINIMUM STORAGE	:	3 Megabytes (Memory)
PERIPHERALS	:	RAMTEK 9400 Series System, VT-100

SOFTWARE:

PROGRAMMING LANGUAGE	:	FORTRAN
DOCUMENTATION IDENTIFICATION	:	ASE Final Report

OPERATION: Real Time/Interactive

SECURITY CLASSIFICATION: Unclassified and Classified versions

POINT OF CONTACT: RADC/IRRP
Mr. L. Converse
Griffiss AFB, NY 13441-5700

AV 587-2217, COM: 315-330-2217

TITLE: BRET - Bistatic Radar Evaluation Tool

DEVELOPER: Technology Service Corporation

STATUS: Currently undergoing modifications.

PURPOSE: To analyze the effectiveness of various bistatic sensor geometries and system parameters.

GENERAL DESCRIPTION: The BRET simulation is a software tool to model different bistatic/multistatic geometries, including bistatically/ multistatically augmented monostatic radar systems, ground, air or mixed configurations, and moving or stationary systems. Sensor parameters can be altered to simulate different systems. A single target can be flown through a series of different maneuvers.

By not including a transmitter in the model geometry, BRET can be used to analyze an ESM/altimeter sensor system. In this operating mode, the simulation has the same flexibility as in the bistatic/multistatic radar mode.

The BRET software consists of three separate programs. TRAJ allows the user to set up sensor geometry and target trajectory. XBSC performs the actual bistatic calculations. The user specifies which outputs are wanted during the execution of XBSC. The third program, PLOT, outputs the data calculated in the XBSC.

The BRET software is currently undergoing modifications. Scheduled for a mid-1986 completion, the enhanced BRET software will include a space based geometry capability, a greater accuracy in its clutter and signal attenuation calculations, a spherical earth coordinate system and an enhanced graphical output.

INPUT: Sensor geometry, system parameters, flight trajectory and output options.

OUTPUT: Tabularized data, graphical representation of data. Possible outputs include target cross section, Signal to Noise (S/N), Signal to Interference (S/I), clutter calculations, signal strength, probability of detection.

MODEL LIMITATIONS: Single target model.

HARDWARE:

TYPE OF COMPUTER	:	VAX 11/780
OPERATING SYSTEM	:	VMS
MINIMUM STORAGE	:	10K
PERIPHERALS	:	Tektronix 40XX or 41XX series terminal

SOFTWARE:

PROGRAMMING LANGUAGE	:	FORTRAN
DOCUMENTATION IDENTIFICATION	:	BRET User's Manual

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/OCTM
Mr. Dan Gentile
Griffiss AFB, NY 13441-5700

AV 587-4434, COM: 315-330-4434

TITLE: BSG - Blue Scenario Generator

DEVELOPER: PAR Government Systems Corporation

STATUS: Operational

PURPOSE: The BSG battlefield simulation model was developed to support the analysis of various types of C3CM techniques (jamming, deception, operations security, etc.). It includes a limited war model which simulates battlefield entities (e.g., military units, vehicles, aircraft, fixed sites, communication networks, jammers, sensors, weapon systems, etc.) and various events (e.g., movement, communications, electromagnetic combat, physical combat, command and control actions, etc.).

GENERAL DESCRIPTION: The BSG simulation model is an enhanced version of the Dynamic Ground Target Simulator (DGTS) also known as version 3.0 of DGTS. It models a two-sided tactical battlefield arena including a limited engagement of up to division sized red and blue ground forces. Airborne army and air force resources are also included. The activity modeled can be of a stochastic nature or be triggered deterministically. The model proceeds in time steps and all scenario activities and events can be stored for further analysis. The ratio of simulation time to real time depends upon the number of units and amount of activity included in the scenario. A test scenario comprised of one soviet regiment and one US Division runs at a ratio of approximately 1:3.

INPUT: Entity data files (military unit descriptions), and initial orders (events that are to be scheduled).

OUTPUT: Interactive color-graphic display of the scenario and a file of all scenario activity (raw data).

MODEL LIMITATIONS: Unit definitions have been developed for a limited set including a US Army tank division, and soviet tank and motorized rifle divisions. Cartographic data bases are presently available for central Europe and Korea only.

HARDWARE:

TYPE OF COMPUTER : DEC VAX 11/750 or larger VAX with at least 3.0 MBytes main memory.
OPERATING SYSTEM : VAX/VMS
MINIMUM STORAGE : 100,000 Blocks Disk Storage.
PERIPHERALS : Ramtek 94XX color-graphic display.

SOFTWARE:

PROGRAMMING LANGUAGE : PASCAL
DOCUMENTATION IDENTIFICATION : User's Manual, Program Maintenance Manual, Technical Report (RADC-TR-85-92)
DOCUMENTATION AVAILABILITY : Technical Report-DTIC, Other-See POC.

OPERATION: Real-time and interactive, or batch.

SECURITY CLASSIFICATION: Model - Unclassified. Entity data files

exist for either Classified or Unclassified scenarios.

POINT OF CONTACT: RADC/COAA
Mr. Jerry L. Dussault
Griffiss AFB, NY 13441-5700

AV 587-4361, COM: 315-330-4361

TITLE: C3I VOICE CONTROL

DEVELOPER: RADC/IRAA

STATUS: Under development

PURPOSE: This element will permit the control of an Advanced Speech Processing Station software system which is similar to one deployed for field testing. The control algorithms are designed to provide in-house research on man/machine interactions, dialog structures and the linguistic aspects of COMINT station control.

GENERAL DESCRIPTION: N/A

INPUT: Live voice

OUTPUT: N/A

MODEL LIMITATIONS: N/A

HARDWARE: To be determined

SOFTWARE:
PROGRAMMING LANGUAGE : LISP
DOCUMENTATION IDENTIFICATION : N/A

OPERATION: N/A

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/IRAA
Dr. James D. Mosko
Griffiss AFB, NY 13441-5700

AV 587-4024, COM: 315-330-4024

TITLE: C3SAM - Command, Control and Communications System Analysis

DEVELOPER: BETAC Corporation

STATUS: Operational at RADC

PURPOSE: The Command, Control and Communications System Analysis Model (C3SAM) is an automated model to assist in tactical C3 Systems development, operational enhancement, and/or reconfiguration. C3SAM is a tool designed to enable individuals and groups to define, structure and analyze tactical Air Force Command and Control. The basic structure and content of the C3SAM data base is representative of a "generic" Tactical Air Control System (TACS) and its command and control relationships with Army, Navy and Marine structures. The operational design of the data base is "user friendly". It will allow non-computer experts the ability to operate the system with relative ease.

GENERAL DESCRIPTION: The C3SAM data is a modified, user friendly version of the Tactical Information Exchange (TIE) data base developed by the Tactical Air Force Interoperability Group (TAFIG) located at Langley AFB, VA. The TIE data base was a three year effort designed to collect, document and organize a complete functional analysis of a generic TACS and its associated information exchanges. RADC's support of this effort resulted in the installation of a copy of the TIE data base on the Honeywell processing system at this location.

INPUT: C2 organizations, functional structures, information products, exchanges between functions and organizations, scenario loading parameters.

OUTPUT: Computer printout

MODEL LIMITATIONS: Information exchanges for all TACS elements in JTF model are not included. MAC model includes wartime only (CORE).

HARDWARE:

TYPE OF COMPUTER : Honeywell DPS 8
OPERATING SYSTEM : GCOS
MINIMUM STORAGE : 35K
PERIPHERALS : High speed printer, magnetic tape, card reader, terminal

SOFTWARE:

PROGRAMMING LANGUAGE : COBOL, JCL
DOCUMENTATION IDENTIFICATION : C3SAM User's Manual

OPERATION: Batch and Interactive

SECURITY CLASSIFICATION: JTF MAC Models: Unclassified
NATO Model (Central Europe): U.S. classified

POINT OF CONTACT: RADC/COAD
Mr. Yale Smith
Griffiss AFB, NY 13441-5700

AV 587-7978, COM: 315-330-7978

TITLE: CS - Consistent System

DEVELOPER: Renaissance Computing, Inc. and The Massachusetts Institute of Technology. MIT owns the system and distributes it to other academic institutions. Renaissance has a sole licensee arrangement with MIT to maintain, extend and distribute CS to non-academic organizations. CS was developed under DARPA and RADC funding administered by RADC.

STATUS: Operational on Multics only. It could be ported to another operating system if sufficent motivation and funding were available. Requires a full PL/1 compiler on the target operating system.

PURPOSE: To provide a very flexible and generalized online data analysis and modeling capability.

GENERAL DESCRIPTION: The main CS user environment contains over 500 user commands, three of which are calls to full blown subsystems:

1. Janus (a relational database management system that functions as the front-end to CS for inputting, merging, cleaning and organizing of data).

2. Discourse (a geographical planning and modeling system that includes a geographically oriented database management system).

3. TSP (Time-Series Processor used for analysis of data that exhibit time-dependent and periodic features and whose language reflects the economist's problem solving domain).

A substantial portion of the CS commands are oriented toward statistical analysis. The whole field of statistical analysis is covered very comprehensively in CS.

CS has an open-ended architecture which makes it easy to add your own tools. It is designed so that subsystems and programs can interchange data and be combined with great flexibility. It has interfaces and escapes that allow it to work with programs that have already been written in various languages.

CS has a wide range of tools not related to statistical analysis, i.e.:

1. Network flow and optimization,
2. Linear programming,
3. Text and concept analysis,

and many others.

CS has a wide range of capabilites for manipulating, decomposing and combining arrays. CS has a very rich macro building capability which allows the user to extend his command repertoire by developing new commands in terms of existing commands.

CS has innumerable ways for presenting and reporting data. It can be combined with the capabilites of the ISSCO Business Graphics package (TELAGRAF and CUECHART).

The statistical analysis tools range from very easy to use simple descriptive statistics methods to some very powerful and highly involved methodologies, a few of which are:

1. Analysis of ordinal categorical data,
2. Multiple linear regression,
3. Principal components analysis,
4. Analysis for variance, and
5. Time-Series analysis.

INPUT: CS works well with all of the known methods of bringing data into Multics, for example, cards, magnetic tape, terminal keyboard, MILNET, ARPANET, Multics files, etc. CS separates those programs that bring data into the system and display it, from those that do analysis.

OUTPUT: The user has a wide variety of options on how to output data, ranging from highly formatted textual reports to various means of plotting data.

MODEL LIMITATIONS: Data structures must usually fit within the bounds of the maximum size Multics segment (1 million bytes). This would interpret to 250,000 numbers in an array or 250,000 records in a Janus dataset (relation). The developer has indicated that he plans to remove these restrictions sometime in the future.

HARDWARE:

TYPE OF COMPUTER : Honeywell DPS-8/70M
OPERATING SYSTEM : Multics
MINIMUM STORAGE : CS occupies 20 million bytes of disk storage. Applications storage depends on the task, the limitation being the amount of disk storage currently available on Multics.
PERIPHERAL : Most applications can be accomplished on a hard copy terminal, however, a terminal with graphics capability is helpful for producing plots.

SOFTWARE:

PROGRAMMING LANGUAGE: User applications are done in CS command language and the various subsystem command languages. The Janus command language resembles so-called 4th generation language systems. Commands can be bundled together into command-line programs or formally made into a macro which functions as a new command. The system can be extended by writing and installing programs written in various languages available on Multics. The majority of the current programs are written in PL/1 with a small portion written in FORTRAN.
DOCUMENTATION IDENTIFICATION: See POC
DOCUMENTATION AVAILABILITY: See POC

OPERATION: Usually interactive, but for jobs that requires huge amounts of resources, it may often be appropriate to run in absentee mode (the Multics equivalent of batch mode).

CLASSIFICATION: The CS system is unclassified, but it can be applied to classified data.

POINT OF CONTACT: RADC/ACDO
Mr. Robert K. Walker or Ms. Mildred (Mitzi) Kobos
Griffiss AFB, NY 13441-5700

AV 587-2501, COM: 315-330-2501, (FT) 952-25011

TITLE: DATOMUT - Computer Simulation of the Detection and Tracking of Multiple Targets in Different Environments

DEVELOPER: RADC/EECT

STATUS: Operational

PURPOSE: To evaluate the performance of various ground based radars in detecting and tracking multiple targets in different environments.

GENERAL DESCRIPTION: A computer model was developed to simulate the detection and tracking of multiple targets by ground based, unattended radars. The model includes such effects as target fluctuations, log normally distributed ground clutter receiver noise, multipath, surface roughness and finite dielectric constant of the earth's surface. The tracking performance of the radar may be evaluated for various targets in different environmental conditions.

INPUT: Target trajectories, environmental clutter cross sections, target cross sections, ground roughness, terrain dielectric constant, transmitter height, wave polarization and frequency.

OUTPUT: Printouts and plots

MODEL LIMITATIONS: Six (6) targets, non-adaptive tracking filters, MTI radar.

HARDWARE:

TYPE OF COMPUTER	:	CDC 6600, CYBER 750
OPERATING SYSTEM	:	160K
MINIMUM STORAGE	:	N/A
PERIPHERALS	:	Calcomp Plotter

SOFTWARE:

PROGRAMMING LANGUAGE	:	FORTRAN
DOCUMENTATION IDENTIFICATION	:	RADC-TR-81-90

OPERATION: Batch

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/EEC
Dr. R. Papa
Hanscom AFB, NY 01731

AV 478-3735, COM: 617-861-3735

TITLE: DDG - Dynamic Data Generator

DEVELOPER: PAR Technology Corporation

STATUS: Complete

PURPOSE: The DDG is being designed to aid in the development of airborne moving target indicator (MTI) radar and weapon delivery systems. This tool will help with the analysis of these systems without the expense of flight testing.

GENERAL DESCRIPTION: DDG simulates the presence of an airborne MTI radar, accepting realistic uplink commands to steer and control the radar, and generating realistic downlink radar data. DDG also simulates the weapons deliveries that are initiated by the Target Acquisition and Weapon Delivery System (TAWDS), now known as Joint STARS (PAVE MOVER). DDG accepts actual commands from the TAWDS Data Processing Control System (DPCS). It is capable of generating plausible weapon flight profiles and responding accurately to TAWDS guidance commands. DDG has the capability to simulate all timing constraints in order to realistically test a TAWDS DPCS in all its functions. However, it is general enough to drive airborne moving target indicator processing systems other than the current DPCS.

INPUT: The Dynamic Ground Target Simulator (DGTS) is the scenario input for the DDG.

OUTPUT: Output of the DPCS is displayed on Ramtek RM-9400 graphics displays. Status of the DDG is displayed on a DEC VS-60 display and a DEC VT-100 terminal.

MODEL LIMITATIONS: Timing problems with the VAX system are preventing "real" real-time operation.

HARDWARE:

TYPE OF COMPUTER : VAX 11/780
OPERATING SYSTEM : VMS V4.0
MINIMUM STORAGE : 3.5 Mb of memory
PERIPHERALS : One (1) VS-60 display, Two (2) Ramtek 9400 displays, Four (4) RM-05 disk drives.

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN '77, Assembly
DOCUMENTATION IDENTIFICATION : N/A

OPERATION: Real-time and Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/COAA
1Lt. John A. Maziarz
Griffiss AFB, NY 13441-5700

AV 587-4494, COM: 315-330-4494

TITLE: DGTS - Dynamic Ground Target Simulator

DEVELOPER: RADC/IRRP: PAR Technology Corporation

STATUS: Operational

PURPOSE: DGTS is a software based system for developing and generating battlefield scenarios to support the development and testing of battlefield management systems. Its purpose is to develop a means for generating data streams and/or files describing the detailed behavior of military units and their associated equipment, along with the environment within which such units operate.

GENERAL DESCRIPTION: DGTS is a flexible, on-line, interactive ground force model simulation system which provides the capability to realistically model the military unit activity within the tactical environment.

- Event driven deterministic and probabilistic simulation capability
- Generation of red and blue forces.
- On-line interactive modification.
- On-going expansion to add detailed air and communication activities (TASRAN/TACOM Interface).
- On-going modifications for generation of large scenarios.

INPUT: Unit, vehicle and emitter data files along with an orders file are utilized to define the required activities according to a written scenario script.

OUTPUT: Formatted messages giving second-by-second information of all the elements in the scenario. This information can be sent on-line to another system, stored on a disk or sent to a graphics system for display purposes.

MODEL LIMITATIONS: Scenarios are limited by the size and location of available digital cartographic data bases. Larger scenarios degrade real-time capabilities.

HARDWARE:

TYPE OF COMPUTER	:	Dec VAX 11/780
OPERATING SYSTEM	:	VMS
MINIMUM STORAGE	:	60,000 blocks disk space 3 Megabytes (Memory-Minimum)
PERIPHERALS	:	RAMTEK 9400 Series System, VT-100

SOFTWARE:

PROGRAMMING LANGUAGE	:	PASCAL
DOCUMENTATION IDENTIFICATION	:	Blue Scenario Generator Final Report

OPERATION: Near-Real-Time, On-line, Interactive

SECURITY CLASSIFICATION: Classified and Unclassified versions

POINT OF CONTACT: RADC/IRRP
Mr. James Papagni
Griffiss AFB, NY 13441-5700

AV 587-2344, COM: 315-330-2344

TITLE: DPGS - Digital Point Geopositioning System

DEVELOPER: RADC/IRRA

STATUS: Under development

PURPOSE: The system's purpose is to develop, validate and demonstrate concepts and techniques of employing computer hardware/software, digital image processing systems, digital memory, mass storage devices and digital data bases for target geopositioning. The system is addressing the development of a significantly improved capability to very quickly and precisely derive the ground coordinates of any target or target related point to support mission planning and strike operations.

GENERAL DESCRIPTION: The Digital Point Geopositioning System (DPGS) is a computer image processor configuration that allows an operator to interactively retrieve an image data base (i.e., digitized aerial photographs) stored on a disk system and view on a CRT monitor the geographic area of interest. By placing a cursor, controlled by the manipulation of a trackball, on the point of interest the system can very quickly and automatically compute the corresponding ground coordinates to a high degree of accuracy. A capability also has been developed wherein an operator can very precisely relate a digital reconnaissance image (IR, FLIR, SAR, OPTICAL) to the data base image. This "Point Transfer" capability allows the determination of coordinates of targets imaged, detected and identified on recent (or nearrealtime) recon imagery but may not be imaged on the data base imagery.

The demonstration, available in RADC's Vault 1327, proceeds through the actual processes and operations indicated above in real time (i.e. game or demo time = to real time).

INPUT: The input into the system is Point Positioning Data Bases, interpreted reconnaissance imagery, numerical information and math model data relating to the reconnaissance imagery and digital terrain elevation data.

OUTPUT: The output of the system is computer displays and printouts of geo coordinates.

MODEL LIMITATIONS: The primary limiting factor is the Point Position Data Bases must be converted into a digital format. Using current in-house capabilities, this results in a very small geographic coverage of the data bases.

HARDWARE:

TYPE OF COMPUTER : DEC PDP-11/70
OPERATING SYSTEM : RSX 11/M
MINIMUM STORAGE : 160K words
PERIPHERALS : DeAnza IP8500 image processor (includes 512 color monitor and trackball), VT-100 keyboard, 2- disks
OTHER EQUIPMENT : EIKONIX scanner/digitizer, RCA Optical Disk "Jukebox" system

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN/MACRO
DOCUMENTATION IDENTIFICATION : Target Location D.B. Software
DOCUMENTATION AVAILABILITY: Manual plus listings

OPERATION: Interactive

SECURITY CLASSIFICATION: The classification of the demonstration is dependent upon the classification of the data bases.

POINT OF CONTACT: RADC/IRRA
Mr. Donald Hall
Griffiss AFB, NY 13441-5700

AV 587-2476, COM: 315-330-2476

TITLE: DSS - Distributed System Simulator

DEVELOPER: General Electric Company, Harris Corporation currently on contract for user-friendly enhancements.

STATUS: Operational

PURPOSE: DSS has been designed as a modeling tool to facilitate the performance analysis of computer networks through simulation. It is implemented in Simscript II.5 (an event oriented simulation language). Its major function is to extend the capability of this language in order to model computer networks.

GENERAL DESCRIPTION: The DSS addresses two broad problems in order to provide a tool for the simulation of computer networks. The first is the wide range of networks, architectures, and protocols that actually exist or have been proposed including message and circuit switched networks. The second major problem addressed by the DSS is the fact that building simulators of complex systems can be a time consuming and costly exercise.

The concept of the DSS model has evolved to meet these problems. A separate DSS model can simulate a single node in a computer network. If two or more nodes have similar characteristics, DSS can duplicate the model as many times as there are similar nodes. This capability greatly reduces the amount of code that has to be generated by the user. These DSS models are then combined to form a simulator of the entire network. DSS Models are not limited to simulating a specific architecture or set of protocols since they have access to all of the high level constructs of Simscript II.5. In particular, any parameterized or structural model may be implemented by a DSS model. There are several advantages to having a separate model for each node. The first is that DSS provides the capability of debugging and verifying DSS models separately. In a network with fifty nodes there may be only two distinct DSS models, one for the switching computers and one for the host sites. Instead of trying to verify a fifty node network simulator, the problem is reduced to verifying two DSS models separately. The second advantage is that a library of DSS models may be created which can focus on particular problems in a network such as flow control or routing algorithms. These DSS Models, whether parameterized or structural models, may be used again in other simulators so that, as the library grows, the time it takes to build a simulator can be reduced in some cases. In this sense, DSS is an extendable system.

The DSS has been used to develop three detailed models of computer networks using the ISO Reference Model as a framework. These detailed models include a communication protocol model, a reliability/availability model and a distributed data base model. These models follow the ISO architecture framework in that each succeeding model uses the services of the preceding model in a hierarchical fashion. The communication protocol model simulates the X.25 interface for packet switched networks. Adaptive routing procedures necessitated by nodal failures are simulated in the reliability/availability model. The distributed data base model was built using the DSS and the facilities provided by the communication protocol and reliability/availability model.

INPUT: There are four main input files to DSS that a user must supply. The first is the file which consists of the DSS models. These models may have been previously defined or created by the user. The second major input file is the topology file (TP.FILE). This file describes the inter-nodal paths connecting the nodes in the network. The third file (M.FILE) specifies for each node in the network the particular DSS model which will simulate it. The fourth file is the EXEC file which specifies whether the channels which connect one node with another are multiplexed or dedicated.

OUTPUT: Computer printout of network performance data and charts.

MODEL LIMITATIONS: None

HARDWARE:

TYPE OF COMPUTER	:	VAX 11/780
OPERATING SYSTEM	:	VMS
MINIMUM STORAGE	:	20,000 blocks
PERIPHERALS	:	VT100

SOFTWARE:

PROGRAMMING LANGUAGE : SIMSCRIPT II.5
DOCUMENTATION IDENTIFICATION : DSS User's Manual, DSS Final Report, DSS Program and Maintenance Manual, DSS Computer Operations Manual.

OPERATION: Batch and/or Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/COTD
Ms. Mary L. Denz
Griffiss AFB, NY 13441-5700

AV 587-3623, COM: 315-330-3623

TITLE: EHF and SHF Link Analysis Program

DEVELOPER: RADC/DCCD

STATUS: Operational

PURPOSE: Analysis of radio propagation at EHF and SHF frequencies.

GENERAL DESCRIPTION: Deterministic air-air and air-ground-air propagation model for radio communication.

INPUT: Frequencies of interest, altitude, rain rate, ranges of interest.

OUTPUT: Plots and computer printouts.

MODEL LIMITATIONS: EHF and SHF frequency bands

HARDWARE:

TYPE OF COMPUTER : Honeywell 6180
OPERATING SYSTEM : MULTICS
MINIMUM STORAGE : 600 lines of source code
PERIPHERALS : 4014 Tektronix Terminal

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN IV
DOCUMENTATION IDENTIFICATION : EHF and SHF Link Analysis Programs (RADC-TM-83-10) and EHF Slant Range Link Analysis Program (RADC-TM-83-19)

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCCD
Mr. Alan Akins
Griffiss AFB, NY 13441-5700

AV 587-3224, COM: 315-330-3224

TITLE: FAP - Forward Area Processor

DEVELOPER: General Dynamics

STATUS: Operational on the Honeywell 8/44D, the SIGINT Support Facility (SSF) VAX 11/780 and the Speech Processing Laboratory PDP 11/70.

PURPOSE: FAP was developed in the mid-seventies to demonstrate an architecture to support the interaction of simulators in an environment. The capability was demonstrated and evaluated using an ELINT platform in a RADAR environment with interactive users and communications. Currently, RADC is upgrading the capability from a batch process, integrating the Dynamic Ground Target Simulator program, expanding the environment, improving the sensor specification capability and interfacing to ASE.

GENERAL DESCRIPTION: The FAP architecture presently provides an ELINT simulation of up to ten (10) sensors, 100 emitters, ten (10) preprocessors, one (1) processor, 25 communicators, five (5) on-line users, a log of all transactions and timing to drive the simulation in an exactly repeatable fashion. This architecture is being expanded to handle SIGINT , create scenarios interactively and and involve up to 25 sensors, 100,000 emitters, 100 processing configurations, 100 communications configurations, 20 on-line reporting and monitoring. The expanded FAP will be compatible with ASE supporting both deterministic and stochastic scenarios.

INPUT: Initial conditions

OUTPUT: Transaction file computer outputs

MODEL LIMITATIONS: The FAP architecture is designed to permit the interface of simulated technology or where it exists, actual hardware. Therefore, the level of simulation is not constrained.

HARDWARE:

TYPE OF COMPUTER	:	Honeywell 8/44D,DEC PDP 11/70,VAX 11/780
OPERATING SYSTEM	:	GCOS, RSX 11-M, VMS
MINIMUM STORAGE	:	52K, 64K, 64K
PERIPHERALS	:	Remote terminal and RAMTEK 9400

SOFTWARE:

PROGRAMMING LANGUAGE	:	FORTRAN, FORTRAN 77
DOCUMENTATION IDENTIFICATION	:	FAP

OPERATION: Batch with interactive and on-line modification

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/IRAE
Mr. William S. Hartnett, AV 587-4517
COM: 315-330-4517
Mr. Alex F. Sisti, AV 587-4517
COM: 315-330-4517
Ms. Margot Risley, AV 587-4517
COM: 315-330-4517

Griffiss AFB, NY 13441-5700

TITLE: GEAP - Guidance Error Analysis Program

DEVELOPER: Questron Corporation/Rome Air Development Center

STATUS: Operational - Enhancements and Extensions in development.

PURPOSE: Detailed analysis of weapons system accuracy of foreign Intercontinental Ballistic Missiles. Based upon estimates of initial condition errors, instrument errors, deployment errors and so on, provided as input by an analysts, this program computes a variety of accuracy measures for the ballistic re-entry vehicle with respect to the intended target. The program is used in developing assessments of the capabilities of foreign ICBM's.

GENERAL DESCRIPTION: Given a specific ICBM trajectory which includes the vehicle state vector as a function of time, a number of error covariance differentiation equations are solved from launch to RV deployment. These results are retained in a file and subsequently combined with estimated error source values and propogated to terminal conditions to evaluate final miss distances. Since a great deal of analysis is performed on a small number of trajectories, there is considerable virtue in the program's method of solution: solution of the error differential equations is done daily once (required about one minute of VAX 11/780 CP time) and specific accuracy analysis can be performed rapidly (about five seconds CP time per weapon system accuracy evaluation) and as often as desired.

INPUT: Estimates of error standard deviations (and optional confidence bounds for them) of specific ICBM error sources.

OUTPUT: Output is in the form of computer printer output. Subsets of information may be selectively output in addition to summary accuracy statistics.

MODEL LIMITATIONS: Incorporation of the ability to treat errors due to geodetic and gravimetric sources is under development. In addition, future development will allow treatment of maneuvering re-entry vehicles.

HARDWARE: The program is operational on a RADC VAX 11/780 and on FTD's IBM 3081 system. For execution on a non-virtual memory system (core- resident program), segmentation would likely be required.

SOFTWARE: The program is coded in FORTRAN 77. The source code is documented with comment lines and the theory and equations are documented in a report available through DTIC. Additional documentation detailing revisions and extensions of the software will be written.

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/IRAP
Capt. Richard M. Floyd
Griffiss AFB, NY 13441-5700

AV 587-7557, COM: 315-330-7557

TITLE: GEMACS - General Electromagnetic Model for the Analysis of Complex Systems

DEVELOPER: The BDM Corporation, Alburquerque, NM

STATUS: Version four under validation. Estimated availability date is January, 1986.

PURPOSE: GEMACS (Version 3) provides the external electromagnetic environment resulting from the radiation and scattering properties of a structure. Analysis is provided of the coupling among collocated antennas, the input impedance and radiation patterns of antennas located on the structure, and scattering of the external electromagnetic environment by the structure itself. Structures can be aircraft, helicopters, huts, etc. Antennas include blades, wires, phased arrays, parabolic dishes. Version four will provide the capability to determine aperture coupling, interior field distribution and coupling to wires and objects interior to the structure skin.

GENERAL DESCRIPTION: GEMACS utilizes finite difference techniques, ray tracing and a matrix approximation and solution to Maxwell's integral equations and requires knowledge of electromagnetic theory and physics. The analysis is performed at discrete frequencies and is valid for both electrically small and electrically large radiating and scattering systems.

INPUT: Using points, lines, surfaces, cylinders and finite difference cells, the user describes the geometry of the structure, including all antennas. The input voltage to any radiating elements as well as a description of the environmental electromagnetic field at the frequency of interest are also provided by the analyst.

OUTPUT: A computer printout is provided detailing the structure model, the electrical parameters input, the calculated input impedance and power dissipated of any radiating elements. Tabular and plotted data are output describing exterior and interior radiation and scattered field distributions. In addition, optional extensive debug information can be requested.

MODEL LIMITATIONS: Radar cross section can be manually calculated using available output (i.e. no provision for computer generated RCS). The shape and size of the structure can be fairly arbitrary, although the skin must be, in general, perfectly conducting. All analyses are performed at discrete frequencies, although time response may be calculated using FFT techniques.

HARDWARE:

TYPE OF COMPUTER	:	Honeywell 6180
OPERATING SYSTEM	:	GCOS
MINIMUM STORAGE	:	180K decimal words
PERIPHERALS	:	One (1) tape handler or disk drive

GEMACS has also been installed on the following computers: CDC 6000, 7600, CYBER 203, DEC 20, VAX 11/780, IBM 370/3033 and 360/92, UNIVAC 1100-43.

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN IV
DOCUMENTATION IDENTIFICATION : Technical Report

OPERATION: Batch

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/RBCT
Mr. K. R. Siarkiewicz
Griffiss AFB, NY 13441-5700

AV 587-2465, COM: 315-330-2465

TITLE: GLS - GACC Laboratory Simulation.

DEVELOPER: PAR Government Systems Corporation.

STATUS: Operational as of 1 Oct 85.

PURPOSE: To simulate the activities of a Ground Attack Control Center. It is a computerized simulation to analyze the functions of this tactical battle management system (GACC) and the software that should be provided to support its mission.

GENERAL DESCRIPTION: The simulation environment includes a set of simulation drivers which model the tactical environment (military activity) and models of various sensor/intelligence systems which would be supplying data to the GACC. The GACC is simulated with a single work station. The simulation scenario is two sided, (enemy ground forces and friendly ground attack and sensor aircraft). The test scenario includes two enemy second echelon divisions and their associated air defense assets, friendly air bases and friendly sensor and direct attack aircraft. The ratio of simulation time to real time is 1:3.

INPUT: The system is designed to run from a battlefield scenario generated by the Dynamic Ground Target Simulator (DGTS). Archived scenarios have been developed and are available on magnetic tape or on disk to serve this purpose.

OUTPUT: The output of this system is the interactive GACC work station and the analysis of the functional capabilities that this work station provides.

MODEL LIMITATIONS: The current limitations are due to simplified models of the sensor, weapons, and intelligence systems that must dynamically interface with the GACC.

HARDWARE:

TYPE OF COMPUTER : DEC VAX 11/780.
OPERATING SYSTEM : VAX/VMS
MINIMUM STORAGE : Approx 200 MBytes of Disk storage.
PERIPHERALS : Ramtek 946X Display.

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN
DOCUMENTATION IDENTIFICATION : System Specification Final Technical Report
DOCUMENTATION AVAILABILITY : See Point of Contact

OPERATION: Real-Time and Interactive only.

SECURITY CLASSIFICATION: Unclassified.

POINT OF CONTACT: RADC/COAA
Mr. Jerry L. Dussault
Griffiss AFB NY 13441-5700

AV 587-4361, COM: 315-330-4361

TITLE: GRASP - Graphic Analysis of System Performance

DEVELOPER: RADC/EEC

STATUS: This simulation is operating. Documentation is not yet completed.

PURPOSE: This simulation was developed to analyze the performance of sited radar systems during the entire target detection and tracking process. The method serves several purposes.One is to evaluate the performance of individual or netted radars in their sited environment and thereby account for clutter, terrain screening, and other external effects peculiar to a specific radar location. Another is to allow direct comparison between the performance of competing radars or different siting arrangements. Finally, the technique presents the results of the analysis in a format that makes them easily understood by the system planner and the nontechnical reviewer as well.

GENERAL DESCRIPTION: The simulation considers individual radars (monostatic or bistatic) to be sited in their proposed locations and in addition to the specified operating characteristics of the radar, includes many external factors such as terrain screening, ground clutter, MTI response characteristics, target RCS variation with aspect angle, and multipath. The target is made to approach along selected intrusion path and the probability of detection is computed at every radar scan interval as a function of the target's position at that time. The detections are used to initiate or establish tracks and to compute the probability of track for each radar in the net. The time history of the encounter is presented on a color display as a simplified plan view of the radar sites, surrounding land, and the approaching (moving) target aircraft. The current tracked and tracking status of the target and radar respectively are indicated by the color or intensity of the symbols representing them on the screen. After displaying the encounter in a compressed time format, a graphical representation of the probability of the track for each radar and for the net are presented. Comparison of two or more such sequences for different conditions makes selection of the system with the superior performance obvious. An introductory sequence explaining the geographical region of the analysis to be shown, a brief discussion of the specific scenarios to be considered, and the definition of the symbols used in the geographical display precede the analysis. A video tApe or a motion picture of the entire graphical analysis displayed on the color monitor is prepared for a permanent record. A verbal description of the introduction, the radar tracking and detection sequences, and a summary of the results is recorded on the video tape or motion picture.

INPUT: The input requires: 1) a specific area of a map marked in rectangular coordinates to relate geographically pertinent parameters, 2) digitized terrain features and clutter values for various types of terrain, 3) operating radar characteristics including antenna patterns and MTI characteristics, 4) radar cross-section of intruder aircraft at various aspect angle and 5) the specific path of the intruder aircraft.

OUTPUT: Video tape and/or motion picture. Voice track describes introduction, dynamic intrusion-tracking segments, and graphical summaries of tracking performance. Results of several engagements for different assumptions are

overlayed for easy comparison. Hard color copies of Introduction, Track Summary Graphs and Conclusions are produced.

MODEL LIMITATIONS: The simulation is limited to no more than seven ground radars, two airborne radars and six airborne intruders.

HARDWARE: The operating system is Network Operating System 2.3. The minimum storage is 100K computer words (octal) on 33K computer words (decimal). Peripheral equipment is a graphical display processor, or Lexidata 3400 Graphic Processor, Color Monitor, NTSC converter, video recorder and data tablet. The program is written for the CYBER 750 that uses 60 bit words. The analysis program can be run without the graphics. In this mode the output data is a table that gives the location and tracking status of each target and radar as a function of time.

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN IV (Extended)
DOCUMENTATION IDENTIFICATION : Not yet completed.

OPERATION: Real-time.

SECURITY CLASSIFICATION: The security classification depends on the classification of input data. The programs are unclassified.

POINT OF CONTACT:

RADC/EEC
Dr. J. Leon Poirier
Hanscom AFB, MA 01731

AV 478-3787, COM: 617-861-3787

RADC/EEC
Richard L. Taylor
Hanscom AFB, MA 01731

AV 478-4270, COM: 617-861-4270

TITLE: HF - High Frequency (HF) Media Simulator

DEVELOPER: Systematron, Inc.

STATUS: Operational

PURPOSE: Provides a controlled simulated HF media environment for test and evaluation of HF communication equipment.

GENERAL DESCRIPTION: The HF Media Simulator was developed based on the Waterson Model. It was designed to interface directly with modems in real time under test, provide the user a convenient means to specify the characteristics of the HF medium simulated.

INPUT: User specified HF medium model parameters via Tektronix 4025 terminal. Data signal input via IOP-16 and special A/D interface from modem.

OUTPUT: HF medium characteristics, test and analysis results (both text and graphics).

MODEL LIMITATIONS: Designed for a baseband of 0-4 KHz only.

HARDWARE:

TYPE OF COMPUTER : PDP 11/40 or 11/60
OPERATING SYSTEM : RSX 11-M Version 3.1
MINIMUM STORAGE : PDP 11/40: 40 K words, AP 120B: 1K Prog Source, 16K Main Data
PERIPHERALS : AP 120B, IOP-16, A/D D/A real time interface

SOFTWARE:

PROGRAMMING LANGUAGE : DEC FORTRAN IV (Host), AP Assembly (AP 120B)
DOCUMENTATION IDENTIFICATION : HF Channel Simulator Operation Handbook

OPERATION: Real time, Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCLF
Mr. J. Evanowsky
Griffiss AFB, NY 13441-5700

AV 587-4567, COM: 315-330-4567

TITLE: HYDRA

DEVELOPER: RADC/COES

STATUS: Under Development

PURPOSE: HYDRA is an experiment to determine the suitability of object oriented programming techniques to battlefield simulation. HYDRA is also a testbed for integrating battle-management decision aides into simulations.

GENERAL DESCRIPTION: The simulation part of HYDRA is a microscopic level of detail air/land battle. Tanks, airplanes, etc. are modeled individually. A knowledge based mission planner and a sensor fusion/analyst will be integrated with the simulation to allow user interaction. The land portion of the battle is currently of division size; it may be increased in the future. Not enough of the system had been implemented yet to predict the ratio of game time to real time.

INPUT: Scenario

OUTPUT: Graphical display of scenario, raw data

MODEL LIMITATIONS: No inherent limitations coded into the design

HARDWARE: LMI Lambda Lisp Machine with IRIS color graphics monitor.

SOFTWARE: Simulation implemented in ROSS. Mission planner implemented in LM-Prolog. Sensor fusion/analyst implemented in ZetaLisp.

OPERATION: Real-time, Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/COES
Lt. Michael L. Hilton
Griffiss AFB, NY 13441-5700

AV 587-7794, COM: 315-330-7794

TITLE: ICAAM - In-house Circular Aperture Antenna Model

DEVELOPER: RADC/IRAE(Lewis Kordus)

STATUS: Operational

PURPOSE: To assist in the development of antenna modeling techniques for use by intelligence analysts. Present version calculates far field antenna beam pattern from knowledge of physical information about the antenna.

GENERAL DESCRIPTION: This package gives the user three methods for determining the far field pattern of a circular aperture antenna (such as a parabolic dish) given in a circularly symmetric aperture field distribution. The first method uses closed form equations containing Bessel functions to determine the beam pattern for uniform, parabolic and parabolic-squared aperture field distributions. The second method uses a built in, fast ROM pack trapezoidal integration to evaluate the Hankel Transform Integral (HTI) numerically, given any well behaved, circularly symmetric aperture field distribution. The third method performs a slower but more accurate Romberg integration to evaluate the HTI.

INPUT: Aperture radius, operating frequency aperture field distribution (uniform, parabolic, parabolic-squared, addition of a pedestal, other circularly symmetric distributions).

OUTPUT: Rectangular plot of the antenna pattern showing nulls, sidelobes, beam-width, etc. Tabular data may also be accessed.

MODEL LIMITATIONS: The aperture field distribution must be circularly symmetric. No capability is provided for determining how the aperture field distribution is affected by contribution such as those from the feed mechanism of a parabolic dish or a circular waveguide. The calculations are valid only in front of the aperture plane.

HARDWARE:

TYPE OF COMPUTER	:	Tektronix 4054A
OPERATING SYSTEM	:	N/A
MINIMUM STORAGE	:	64K
PERIPHERALS	:	Floppy disk drive, Signal Processing ROM Pack Unit

SOFTWARE:

PROGRAMMING LANGUAGE	:	BASIC (Advanced Tektronix)
DOCUMENTATION IDENTIFICATION	:	Not yet available

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/IRAE
Mr. Mark G. Alford
Griffiss AFB, NY 13441-5700

AV 587-7152, COM: 315-330-7152

TITLE: ICNAS - Intelligence Communications Network Analysis System

DEVELOPER: Rockwell International INCO, Inc.

STATUS: Operational

PURPOSE: To analyze performance of communications networks in support of dissemination of intelligence data/products.

GENERAL DESCRIPTION: ICNAS is an intelligence communications network analysis tool which, along with its data base, may be used to identify potential strengths and weaknesses in an existing or proposed imagery/signals intelligence (IMINT/SIGINT) communications network. ICNAS is rendered specific to IMINT/SIGINT networks by its data base. The data base (classified SECRET) contains data describing existing IMINT/SIGINT communications networks, such as network nodes, circuits, equipment and messages (the data base may be expanded or changed to accommodate other types of communications networks). The network analysis subsystem can be exercised in a stand-alone mode independent of the data base subsystem.

ICNAS evaluates message switched store-and-forward telecommunications network based on performance, effectiveness, survivability and susceptibility (to physical or electronic threats).

INPUT: Network configuration data and types and volumes of traffic via magnetic tape and keyboard.

OUTPUT: Data from the data base, and analysis data/results from the analysis module, provided in tabular and graphics (color) form.

MODEL LIMITATIONS: Designed to analyze via analytic models of store-and-forward models, Packet Switching networks, Time Division Multiple Access (TDMA) networks and Packet Radio only.

HARDWARE:

TYPE OF COMPUTER	:	PDP 11/70 (or larger) CPU
OPERATING SYSTEM	:	RSX 11-M
MINIMUM STORAGE	:	46,080K bits of disk storage
PERIPHERALS	:	Ramtek 9400

SOFTWARE: DOCUMENTATION IDENTIFICATION : User's Manual, Program Maintenance Manual, Data Base Specification, System/Subsystem Specification and Final Technical Report.

OPERATION: Interactive non-real-time

SECURITY CLASSIFICATION: Classified (only the data base content is)

POINT OF CONTACT: RADC/DCLF
Mr. Peter Leong
Griffiss AFB, NY 13441-5700

AV 587-4567, COM: 315-330-4567

TITLE: ICS - Interactive Communications Simulator

DEVELOPER: Rensselaer Polytechnic Institute - Original Version
PAR Technology Corporation - Enhanced Version

STATUS: Operational

PURPOSE: To provide a high speed, high resolution specialized capability for the design and analysis of communication links modeling/simulation signal processing techniques.

GENERAL DESCRIPTION: The ICS is a highly efficient, expandable and user friendly modeling and simulation tool for the evaluation and development of advanced digital communication signal processing techniques. The ICS has a fixed modeling topology; its modeling structure is a classical breakout of the various generic signal processing functions and environment in any communication link, i.e. source/sink, source/encoding/decoding, channel encoding/decoding, modulation/demodulation, transmitter/receiver and propagation channel. These signal processing functions are predominately modeled in terms of their complex envelope representations for uniformity, ease and accuracy of analysis. Monte Carlo simulation technique is employed.

The hardware system that may be used to support the ICS is any DEC PDP 11 series computer with a peripheral graphics display processor and a peripheral Floating Point Systems AP-120B Array Processor. The PDP 11 host handles all of the utility and housekeeping functions and interacts with the users via the graphics and teletype terminals. It "assembles" the entire simulation job according to the user's selections and unloads the job to the AP-120B for dedicated execution. This partitioning of tasks between the two processors results in highly efficient computations and ease-of-use.

The original version of ICS features a 3-path dispersive fading and an impulsive noise channel model, in addition to an Additive White Gaussian Noise (AWGN) channel model. The enhanced version features spread-spectrum modulation/demodulation, quad-diversity channel design capability and jamming signal sources.

OUTPUT: Graphics, visual, hard copy, help files.

MODEL LIMITATIONS: Now, the ICS is for a single user. But even when implemented with the RSX 11-M, more than one ICS job requiring concurrent use of the AP-120B would overload the system, if not unfeasible. However, for those portions of the ICS job handled by the PDP 11 host multiple jobs may be accommodated at the same time. The enhanced version has outgrown the PDP 11 host. Any future expansion can only be effectively implemented using the VAX as the host.

HARDWARE:

TYPE OF COMPUTER : PDP 11/40, PDP 11/60, VAX 11/780
OPERATING SYSTEM : RT-11, single user, RSX 11-M, multiuser, VAX/VMS.
MINIMUM STORAGE : PDP 11/40: 28K. System 80K available. AP-120B: Program source memory 2.5K (64 bit word). Main data memory 32K

required (38 bit word) has 40K available in system.
PERIPHERALS : AP-120B, DEC VT-11 Graphics terminal and DEC writer.

SOFTWARE:
PROGRAMMING LANGUAGE : For Host (PDP 11/40): DEC FORTRAN IV. For Array Processor (AP-120B): AP Assembly Code.
DOCUMENTATION IDENTIFICATION : Program Listings, Technical Report and Technical Memos.

OPERATION: Interactive, usually to one user at a time, even though the host can be operated in a multi user environment.

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCLF
Mr. Peter K. Leong
Griffiss AFB, NY 13441-5700

AV 587-4567, COM: 315-330-4567

TITLE: ICSSM - Interactive Communication Systems Simulation Model

DEVELOPER: Hazeltine Corporation

STATUS: Operational

PURPOSE: To provide a general, flexible computerized modeling and simulation structure to support design and analysis of various communications systems, links and equipment.

GENERAL DESCRIPTION: The Interactive Communicatons Systems Simulation Model (ICSSM) is a non-real-time digital-computer-based system intended for simulating point-to-point communications systems. The ICSSM has the capability of supporting simulation and modeling of a system which can be represented in terms of a network of multi-port functional blocks. Its applicability is restrained only by the modeler's ingenuity to decompose and represent algorithmically his system by these functional blocks. Therefore, the ICSSM has the capability to model and simulate practically any digital communication system.

There is an application library that is an integral part of ICSSM. This library is to facilitate storage, and access of all application software whether it is modeling/simulation modules, analysis subroutines or computer graphic subroutines.

Consequently, the user/analyst may benefit from the legacy of previous modeling efforts. The ICSSM also has a preconfigured programming structure which allows the user/analyst to concentrate on model formulation. Thus, the construction of a special simulation framework or system for each simulaton endeavor is avoided.

The ICSSM is a simulation and modeling tool that can easily accommodate any conceivable future growths (i.e. both system and application related enhancements), to support new communication system development needs.

INPUT: Via Tektronix 4014

OUTPUT: Graphics display and hardcopy

MODEL LIMITATIONS: Scope and fidelity of model and simulation are mainly dependent on the variety and fidelity of the simulation software, and analysis software residing in the library. The ICSSM system software is totally neutral.

HARDWARE:

TYPE OF COMPUTER	:	Honeywell DPS 7/80M, VAX 11/780
OPERATING SYSTEM	:	MULTICS, VAX/VMS
MINIMUM STORAGE	:	2000 pages of disc memory
PERIPHERALS	:	Tektronix 4014

SOFTWARE:

PROGRAMMING LANGUAGE : ANSI standard FORTRAN
DOCUMENTATION IDENTIFICATION : Technical report, system/subsystem specifications, user's manual, program maintenance manual, functional description.

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCLF
Mr. Peter Leong
Griffiss AFB, NY 13441-5700

AV 587-4567, COM: 315-330-4567

TITLE: IEMCAP - Intrasystem Electromagnetic Compatibility Analysis Program

DEVELOPER: McDonnell Douglas Corporation

STATUS: Operational

PURPOSE/GENERAL DESCRIPTION: The Intrasystem Electromagnetic Compatibility Analysis Program (IEMCAP) is a deterministic model designed to provide the basic system-level intrasystem electromagnetic compatibility (EMC) analysis. Its output is in the form of a digitized EMC database. It performs four functions.

The first function is the baseline system EMC survey. The system is surveyed for interference. If the maximum of the electromagnetic interference margin over the frequency range for a coupled emitter-receptor port pair exceeds the user specified printout limit, a summary of the interference is printed. Total received signal into each receptor from all emitters is also printed.

The second function is the trade-off analysis. This function compares the interference for a modified system to that stored from a previous specification generation or survey run. Thus, the effect on interference of antenna changes, filter changes, spectrum parameter changes, wire changes, etc... can be assessed.

The third function is specification waiver analysis. This function shifts portions of specific port spectra as specified and compare the resulting interference to that stored from previous analysis. Thus, the effect of granting waivers for specific ports can be assessed.

The final function is specification generation. The initial nonrequired emission and susceptibility spectrum is adjusted such that the system is compatible. The user specified adjustment limit prevents too stringent adjustments. A summary of interference situations not controllable by EMC specifications is printed. The adjusted spectra are the maximum emission and minimum susceptibility specifications for use in EMC tests.

INPUT: Electromagnetic characteristics of the system.

OUTPUT: Computer printout.

MODEL LIMITATIONS: Designed to have a rough cull of the electromagnetic compatibility posture of a total system. There are limitations on the various numbers of components that can be analyzed in any one activity, although activities can be sequentially executed.

HARDWARE:

TYPE OF COMPUTER	:	Honeywell DPS 8
OPERATING SYSTEM	:	GCOS
MINIMUM STORAGE	:	Approximately 85K decimal
PERIPHERALS	:	Any standard computer terminal

SOFTWARE:
PROGRAMMING LANGUAGE : FORTRAN IV
DOCUMENTATION IDENTIFICATION : Engineering Manual, User's Manual

OPERATION: Batch

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/RBCT
Mr. Anthony J. Pesta
Griffiss AFB, NY 13441-5700

AV 587-7642, COM: 315-330-7642

TITLE: IIPL - Intelligence Information Processing Lab

DEVELOPER: RADC/IRD

STATUS: Under Development, anticipated FY86. Preliminary baseline configuration, the IIPL (Intelligence Information Processing Laboratory), is currently operational.

PURPOSE: To assist intelligence information system development and intelligence technology advanced development, both contractual and in-house.

GENERAL DESCRIPTION: Not a model or simulation per se, but a hardware/software configuration to support modeling and simulation. The configuration currently includes DEC VAX and PDP11 computers and peripherals including disk, tape, printers, textual and graphic terminals. A rapid prototyping capability is planned for development in FY84 and FY85 as the first system development modeling aid residing in the IIPL.

INPUT: Intelligence information (messages, file updates, sensor data).

OUTPUT: Computer printout, plots, graphics, interactive terminal test and graphics, statistically analyzed data.

MODEL LIMITATIONS: Requires applications development.

HARDWARE:

TYPE OF COMPUTER : PDP11, VAX 11/780
OPERATING SYSTEM : IAS, VMS
MINIMUM STORAGE : 512 Kw
PERIPHERALS : Tape, disk, line printer, Tektronix colorgraphics terminal, VT100 terminals, Imlac PDS4 graphics display system, SU1652 graphics terminal, Chromatics CGC 7900 graphics display system, Genesco CGT 3000 Graphic display processor, Summagraphics data tablet/digitizer.

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN, COBOL
DOCUMENTATION IDENTIFICATION : Intelligence Information Processing Laboratory Plan, 1 August 83

OPERATION: Batch. Interactive to be developed FY84/85.

SECURITY CLASSIFICATION: Unclassified and Classified

POINT OF CONTACT: RADC/IRDA
Mr. Bob Herrmann
Griffiss AFB, NY 13441-5700

AV 587-3221, COM: 315-330-3221

TITLE: IN - Integrated Node

DEVELOPER: RAC Corporation

STATUS: Operational

PURPOSE: The Integrated Node was developed to demonstrate feasibility of integrated switching. It will be used to evaluate Integrated Services Digital Network (ISDN) Recommendations and other innovative integration techniques and their impact on the evolving Defense Communications System (DCS).

GENERAL DESCRIPTION: The Integrated Node is a versatile and modular communications switching node. It provides packet switching (resource sharing and host-to-host linking of a wide variety of computers) to handle asynchronous but near real-time data transactions to accommodate needs such as man/man, man/computer and computer/computer communications as well as circuit switching for real-time voice. In order to functionally test the node, the signal Integrated Node was modified to emulate a three node network. Using this configuration, RCA successfully demonstrated integrated packet, message and voice switching functions as well as the operation of dynamic channel allocation.

INPUT: N/A

OUTPUT: N/A

MODEL LIMITATIONS: Limited to the number of ports. Currently limited to: 1) Phones: 6 CVSD, 2) Message Terminals: 6 MODE I and 8 MODE II, and 3) Packet Terminals: 6 HOST.

HARDWARE:

TYPE OF COMPUTER : Perkin-Elmer 8/32
OPERATING SYSTEM : OS32MT Rev. 5.2
MINIMUM STORAGE : 451 KBS
PERIPHERALS : Owl 1100 Console, 300 LPM Printer, 10 MB disk storage and (2) 800 BPI tape drives.

SOFTWARE:

PROGRAMMING LANGUAGE : Perkin-Elmer Assembly (CAL)
DOCUMENTATION IDENTIFICATION : Operations Manual

OPERATION: Real-Time

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCLD
Mr. John Salerno
Griffiss AFB, NY 13441-5700

AV 587-7751, COM: 315-330-7751

TITLE: IRSS - Interactive Radar System Simulator
(Formerly RADSIM - Radar System Simulator)

DEVELOPER: RADC/OCTM

STATUS: Operational

PURPOSE: This model simulates waveforms and their interaction with chaff, targets, propagation effects and clutter.

GENERAL DESCRIPTION: The IRSS program is a detailed signal simulation composed of modular "building blocks" that simulate the various subsystems, functional elements and components commonly found in radar systems. The program can simulate radar signals in both amplitude and phase as they are generated, propagated through the environment, reflected by scatterers and processed in the receiver, signal processor, and postdetection processor. The user may simulate and entire radar system or only portions of it to nearly any degree of sophistication.

The simulation is highly interactive and written from the radar engineer's viewpoint - not a computer programmer's. Automatic error checking examines the user's inputs for correct format and for a reasonable range of values. Information retrieval is also available on-line which enables the user to easily obtain information on commands and parameters prior to starting a simulation run.

The simulation can store input data and results. Permanent storage of all input commands and data can be requested, allowing the user to run the same simulation or similar simulations easily at a later time. Temporary storage is also available, allowing the user to loop through a sequence of commands several times, altering one or more parameters on each pass. This simplifies the execution of parametric analyses. Finally, all output results can be permanently stored at the request of the user.

The modular structure of the simulation simplifies the incorporation of additional capabilities and real-world data.

INPUT: Waveform patterns, digital filter parameters, jammers, signal processing parameters.

OUTPUT: Computer printouts, three dimensional ambiguity plots, voltage and power plots, color graphics available.

MODEL LIMITATIONS: Fast Fourier Transform buffer size is fixed at the time that the executable program image is generated. If the user attempts to execute a transform which is too large, or, if the input file is larger than the size of the transform (2048 x 2048) error messages will be printed and simulation will await correct user inputs before proceeding.

HARDWARE:
TYPE OF COMPUTER : VAX 11/780

OPERATING SYSTEM : VAX/VMS Version V4.1
MINIMUM STORAGE : 2.4 megabytes
PERIPHERALS : Tek 4014 hooked to a Tek 4631, Tek 4107 hooked to a Tek 4695

SOFTWARE:
PROGRAMMING LANGUAGE : FORTRAN
DOCUMENTATION IDENTIFICATION : Program Maintenance Manual, User's Manual

OPERATION: Interactive or Batch

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/OCTM
Mr. Stan Borek
Griffiss AFB, NY 13441-5700

AV 587-4431, COM: 315-330-4431

RADC/OCSA
Mr. John Cleary
Griffiss AFB, NY 13441-5700

AV 587-3573, COM: 315-330-3573

TITLE: ISAE - Intelligence System Architecture Evaluation

DEVELOPER: Martin Marietta Corporation

STATUS: Under development; expected Fall 1985

PURPOSE: This is a hardware software system to build and modify software prototype models of intelligence functions, processes, subsystems and systems using rapid prototyping techniques for intelligence system evaluation and problem solving. The primary problem the model addresses is determination of content and form of an analysts output and the secondary problem is determination of system resources to support that task.

GENERAL DESCRIPTION: This system provides an easy to use extension to the tools provided with an Apollo workstation. A rapid prototype man/ machine interface can be built using the Apollo workstation with natural language commands and data base query, forms input and output, graphics input and output and other model development aids.

These tools are linked to three performance modelers resident on the VAX:

(1) GOM : General Operator Model - a state transition model for defining tasks and their relationships that occur in an intelligence processing center.

(2) GPM : General Processor Model - a data driven, viewer accessed modeling tool for defining and executing detailed logical and physical ADP architectures.

(3) FAM : Functional Allocation Model - a data driven, menu accessed, prototyping tool to aid the transition from operational analysis of a C3I system to a preliminary design.

INPUT: Scenario built from provided software tools and/or computer/network architecture to be performance evaluated.

OUTPUT: Screen data on hardware/software performance.

MODEL LIMITATIONS: Unknown

HARDWARE:

TYPE OF COMPUTER	: VAX 780	APOLLO DN550
OPERATING SYSTEM	: VMS 2-1	AEGIS (UNIX+)
MINIMUM STORAGE	: APPROX. 30MB	APPROX. 30 or 13
PERIPHERALS	: (2) 30MB DISK	(1) 50MB DISK
	VT 100 DISPLAY	KB, MOUSE
	DECWRITER	

SOFTWARE:

PROGRAMMING LANGUAGE : UNKNOWN PROLOG C

DOCUMENTATION IDENTIFICATION : GPM Tech Vol Users Guide, GOM Tech Vol Users Guide, FAM Tech Vol Users Guide, Interim Tech Report

DOCUMENTATION AVAILABLE: Sept, 1985, IRDA

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/IRDA
Mr. W.R. Herrmann
Griffiss AFB, NY 13441-5700

AV 587-3221, COM: 315-330-3221

TITLE: LOS ECM Simulator - Line-of-Sight Electronic Counter Measures

DEVELOPER: Signatron, Inc.

STATUS: Operational

PURPOSE: To provide jamming sources combined with signals from line-of- sight simulator so to create an ECM environment for TE of LOS radio equipment at three (3) RF ranges and four (4) IFs.

GENERAL DESCRIPTION: The Line-of-Sight (LOS) Electronic Counter Measures (ECM) Simulator operates in conjunction with a LOS communication simulator to simulate in a laboratory environment LOS communication with jamming. It provides jamming sources combined with signals from the LOS simulator creating an ECM environment for test and evaluation of LOS radio equipment at three radio frequencies (RF) and four intermediate frequencies (IF). The LOS ECM Simulator can test modems at 70, 100, 300 and 700 MHz IFs and receivers at 1-1.5, 4.4-5.0 and 7.1-8.4 GHz RFs.

The ECM Simulator consists of four major sections. The first is the SIngle LOS/Dual Tropo Jammer source. This generates IF signals to simulate a jammer broadcasting to a LOS receiver. The second major section is the Jammer Delay-Combiner/AGC which combines the desired RF communications signals with appropriately delayed IF jammer signals for simulation of off-axis jamming. A 70 MHz AGC amplifier for testing modems requiring external AGC capability is also contained in this section. The IF/RF interface is the third major section. This section converts the previously mentioned IF signals to RF for testing of receiver front ends. The fourth major section is the power supply section.

INPUT: Analog in (IF)

OUTPUT: Analog out (IF/RF)

MODEL LIMITATIONS:

a. IF: 70 MHz, 100MHz and 700 MHz
b. BW: +/- 12.5 MHz, +/- 25 MHz, +/- 50 MHz respectively
c. RF: 1-1.5 GHz, 4.4-5.0 GHz and 7.1-8.0 GHz
d. One jammer type can be used at a time
e. 70 MHz IF jammer module may be used to provide additional direction of jamming when used with the tropo ECM simulator and tropo simulator for tropo applications.

HARDWARE:

TYPE OF COMPUTER : Unique dedicated hardware design
OPERATING SYSTEM : N/A
MINIMUM STORAGE : N/A
PERIPHERALS : N/A

SOFTWARE:

PROGRAMMING LANGUAGE : N/A
DOCUMENTATION IDENTIFICATION : Technical Report, Operating/ Maintenance Manual with schematics and parts list. Quality is good.

OPERATION: Real-time, direct connection to equipment undergoing test.

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCLF
Mr. Peter Leong
Griffiss AFB, NY 13441-5700

AV 587-4567, COM: 315-330-4567

TITLE: LPC-10 Simulation

DEVELOPER: RADC/IRAA

STATUS: Operational

PURPOSE: The simulation is used in in-house basic research to investigate the interactions between human voice characteristics and low data rate communications.

GENERAL DESCRIPTION: The system consists of a series of modules which can be used to model the DOD Standard LPC-10, 2400 bits per second vocoder. Modifications to the modules permit transmission rates down to 400 bits per second.

INPUT: The standard input is pre-stored digital speech samples.

OUTPUT: The output is a synthesized version of the input speech.

MODEL LIMITATIONS: N/A

HARDWARE:

TYPE OF COMPUTER	:	PDP 11/70; 11/45
OPERATING SYSTEM	:	RSX-11M
MINIMUM STORAGE	:	N/A
PERIPHERALS	:	Standard A/D, D/A; Interactive graphics

SOFTWARE: Interactive Laboratory System, FORTRAN 77

OPERATION: N/A

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/IRAA
Dr. James D. Mosko
Griffiss AFB, NY 13441-5700

AV 587-4024, COM: 315-330-4024

TITLE: MAFIA - Modeling Aids for Intelligence Analysts

DEVELOPER: Synectics Corporation

STATUS: Under Development

PURPOSE: Develop model building aids for intelligence analysts, such that a computer non-specialist can build and modify models of real world situations.

GENERAL DESCRIPTION: A series of machine based analytical tools called the Modeling Aids Support Package (MASP) is intended to demonstrate the feasibility of providing modeling aids to intelligence analysts to represent loosely structured, qualitative, and, sometimes, incomplete data. Although this package will be widely applicable to intelligence activities, a specific intelligence problem context has been selected for a demonstration. The selected problem is that of a Military Airlift Command (MAC) terrorist analyst. The emphasis of the MASP demonstration will be one the acquisition and representation of analyst knowledge by using an "if than" type of rule structure.

INPUT: Intelligence information

OUTPUT: Intelligence reports containing a list of possible probabilities of the occurrence of each event.

MODEL LIMITATIONS: To be determined.

HARDWARE:

TYPE OF COMPUTER	:	Apple Lisa 2
OPERATING SYSTEM	:	MACOS
MINIMUM STORAGE	:	1 megabyte
PERIPHERALS	:	5 megabyte hard disk

SOFTWARE:

PROGRAMMING LANGUAGE	:	PASCAL
DOCUMENTATION IDENTIFICATION	:	N/A

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/IRDT
Mr. John J. Maier
Griffiss AFB, NY 13441-5700

AV 587-2171, COM: 315-330-2171

TITLE: MODEC - Motor Optimization Design and Evaluation Code

DEVELOPER: Aerojet Techsystems Company, Air Force Rocket Propulsion

STATUS: Operational - Adaptation to interactive execution underway

PURPOSE: To perform simultaneous automated design synthesis on both rocket motor performance capability and trajectory shape.

GENERAL DESCRIPTION: Through extensive input options, the analyst can design/model a multi-stage rocket composed of individual solid and/or liquid stages. It evaluates the size, weight and performance of system components over a range of design configurations , materials of construction and operational points. The purpose of this program then is to determine the optimum vehicle designs for specified mission requirements.

INPUT: A file consisting of a number of namelist blocks is used for input. The input variables are extensive and detailed. They relate to the components of individual stages, trajectory and guidance variables, and control of the optimizer. The program is being modified to allow simpler interactive execution.

OUTPUT: Output (including carriage control characters) is written to a file. The output includes labeled numeric output and line-printer type plots. Future work will streamline the output for interactive execution and graphical output will be plotted on higher resolution output devices.

MODEL LIMITATIONS: The trajectory model uses a two-dimensional round non-rotating earth representation and the vehicle model does not include rotational degrees-of-freedom. Neither of these are significant for the purposes of this program.

HARDWARE: The original program operates in single-precision on the CDC computer. The existing modified program executes in double-precision on the VAX 11/780 at RADC and on the IBM 3081 system at FTD. For execution on a non-virtual memory system (core-resident program), segmentation would be required.

SOFTWARE: The program is coded in FORTRAN 77. The equations underlying the code, the necessary inputs and the capabilities of the program are described in reports available through DTIC. Additional documentation detailing revisions and extensions of the software will be written.

OPERATION: The program is currently pseudo-interactive and will be modified to increase the I/O treated interactively.

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/IRAP
Capt. Richard M. Floyd
Griffiss AFB, NY 13441-5700

AV 587-7557, COM: 315-330-7557

TITLE: NCAP - Nonlinear Circuit Analysis Program

DEVELOPER: Original Version: Signatron, Inc.
Present Version: RADC (In-house)

STATUS: Verified and available

PURPOSE: This program does a frequency domain analysis to calculate the nonlinear transfer functions of electronic circuits.

GENERAL DESCRIPTION: As originally configured, NCAP computed the nonlinear transfer functions of an electronic circuit, where the nonlinear transfer functions of order 'n' was the Fourier Transform of the nonlinear impulse response of order 'n'. It has been shown that the nonlinear transfer functions which are based on the Volterra Series, are related to quantities of interest to EMC engineers (e.g. intermodulation, cross modulation, demodulation, desensitization, etc...). The original NCAP, written in FORTRAN IV, directly analyzed networks containing up to 50 nodes, had a fixed field format for input data, and contained a small number of built in electronic device models.

The NCAP Program solves the nonlinear network problem by forming both the nodal admittance matrix (Y matrix) for the entire network and the current vector for all orders of analysis. The circuit generators can be located between any nodes in the network, and can have any desired frequency, amplitude and phase. At each excitation frequency, the admittance matrix and current vector are obtained and used to derive the transfer function vector, the elements of which are the transfer functions for the nodes in the network. Higher order transfer functions are solved iteratively.

Subsequent to the original development, RADC devoted an extensive amount of effort into NCAP to make it more user oriented, to expand its capabilities and to provide documentation for both EMC Engineers and computer software specialists. Presently, NCAP analyzes networks on the order of 750 nodes, has a free field format for input data, has capabilities to allow the user to build device models in addition to the several stored models and has a more user oriented format.

INPUT: The only input required is a circuit description which is a file containing a collection of NCAP input descriptors. The descriptors are explained in the User's Manual TR-69-245, Vol. II.

OUTPUT: Printouts

MODEL LIMITATIONS: The nonlinearities in the circuit must be weak nonlinearities (i.e., series with slowly varying excitation). The number of device/elements and the size of the circuit are limited only by the storage capacity of the computer. The present form is set to approximately 750 nodes.

HARDWARE:

TYPE OF COMPUTER	:	Honeywell DPS 8
OPERATING SYSTEM	:	GCOS
MINIMUM STORAGE	:	50K
PERIPHERALS	:	Disk storage for seven (7) intermediate files.

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN IV
DOCUMENTATION IDENTIFICATION : RADC-TR-79-245, Vol. III

OPERATION: Batch

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/RBCT
Mr. Jon B. Valente
Griffiss AFB, NY 13441-5700

AV 587-3490, COM: 315-330-3490

TITLE: NISA - Numerically Integrated Elements for Systems Analysis

DEVELOPER: Engineering Mechanics Research Corporation

STATUS: Operational

PURPOSE: To assess the reliability of microelectronic devices by analytically simulating thermal and mechanical environments.

GENERAL DESCRIPTION: Finite element code to simulate thermal, mechanical, and dynamic loadings. These loads can be applied to any modeled device from large space structures to microelectronic devices. Analyses results include deflections, stresses, frequencies of vibration and mode shapes that can be displayed graphically.

INPUT: Physical and geometric descriptions of modeled device, material properties, boundary conditions, applied loads.

OUTPUT: Numerical and graphical response data including deflected shapes, thermal contours and stress contours.

MODEL LIMITATIONS: Limitations are described in terms of a maximum wavefront for solution of the matrix equations. Model limitation is a wavefront of 500.

HARDWARE:

TYPE OF COMPUTER	:	Honeywell 8/44D
OPERATING SYSTEM	:	GCOS 4JS3
MINIMUM STORAGE	:	40K words
PERIPHERALS	:	Tektronix 4115 terminal and Tektronix 4695 copier.

SOFTWARE:

PROGRAMMING LANGUAGE	:	FORTRAN (available: object code only)
DOCUMENTATION IDENTIFICATION	:	User's Manual

OPERATION: Model generation and graphical output manipulation are done interactively. Numeral solutions to generate the output are done in the batch mode.

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/RBES
Mr. William J. Bocchi
Griffiss AFB, NY 13441-5700

AV 587-2101, COM: 315-330-2101

TITLE: PAAS - Parametric Antenna Analysis Software

DEVELOPER: RADC/OCSA

STATUS: Operational

PURPOSE/GENERAL DESCRIPTION: This software was developed to perform parametric analysis of antennas. Several OC simulations will be integrated into the IRESM (Integrated Radar Environment Simulator). IRESM will be installed on the OC VAX 11/780. IRESM will be a general model applicable to a broad range of radar systems.

INPUT: Antenna parameters, number of bits in phase shifter, etc...

OUTPUT: Computer printouts, three dimensional plots, pattern cuts, histograms, numerical data.

MODEL LIMITATIONS: Any array which can be accurately modeled by an array of up to 100 X 100 sample points can be treated via this software package.

HARDWARE:

TYPE OF COMPUTER	:	VAX 11/780
OPERATING SYSTEM	:	GCOS
MINIMUM STORAGE	:	1.9 million words
PERIPHERALS	:	Remote terminal

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN
DOCUMENTATION IDENTIFICATION : User's Manual, Program Maintenance Manual

OPERATION: Batch or Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/OCSA
Mr. John C. Cleary
Griffiss AFB, NY 13441-5700

AV 587-3573, COM: 315-330-3573

TITLE: QM-1 - Microprogrammable Computer

DEVELOPER: Nanodata Corporation

STATUS: Operational

PURPOSE: The Nanodata QM-1 minicomputer is designed to allow users to evaluate various computer architectures with the use of emulation technology.

GENERAL DESCRIPTION: The QM-1 is microprogrammable on two levels (microcode and nanocode) and by properly utilizing this flexibility, maximum performance can be achieved. For ease of use, A Hardware Description Language (HDL) with high level language constructs called Smite is available. This language is used to describe the machine at the register transfer level (RTL) and compiles to QM-1 microcode. There also exists a tool, the Meta Assembler, which allows the user to create assembly language programs for his specific machine.

INPUT: Microcoded emulations of a specific computer architecture.

OUTPUT: The status of a machine at any given point in time (i.e., contents of PC, IR, memory location, etc...).

MODEL LIMITATIONS: All conventional computer architectures currently available can be created using the system (i.e., IBM 360, MIL-STD-1750A, MIL-STD-1862B, etc...).

HARDWARE: Honeywell DPS-8 with the MULTICS operating system. DEC System-20 with the TOPS-20 operating system. The QM-1 microprogrammable computer is a TOPS-20 peripheral.

SOFTWARE:

PROGRAMMING LANGUAGE: The SMITE compiler is written in PL1.
The QM-1 hosts several different languages.
DOCUMENTATION IDENTIFICATION : Advanced SMITE Reference Manual (RADC-TR-80-66); Meta Assembler, MDAC Meta Assembler User's Manual, Contract No. F09603-80-6-3987

OPERATION: Smite compiler is operated in on-line batch mode. The QM-1 is operated in real-time, interactively.

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/COTC
Mr. Robert L. Kaminski
Griffiss AFB, NY 13441-5700

AV 587-2925, COM: 315-330-2925

TITLE: QPRIM-QM-1 - Programmer's Research Instrument System

DEVELOPER: USC/ISI

STATUS: Operational

PURPOSE: QPRIM is a facility which allows the interactive use of the RADC QM-1 microprogrammable computer by remote users via the ARPANET.

GENERAL DESCRIPTION: QPRIM provides an environment for running and debugging Smite-written emulators and their respective target software. QPRIM runs on a TOPS-20 operating system and uses the QM-1 microprogrammable computer as a backend emulator engine. QPRIM software allows users to examine and change all aspects of the target machine and many aspects of the QM-1 host interactively.

INPUT: A Smite compiled emulator and a separate description of the emulator.

OUTPUT: The current state display of the target machine (i.e., contents of PC, IR, memory locations, etc...).

MODEL LIMITATIONS: N/A

HARDWARE: The DEC System-20 with the TOPS-20 operating system. The QM-1 microprogrammable computer is a TOPS-20 peripheral.

SOFTWARE:
PROGRAMMING LANGUAGE : BLISS
DOCUMENTATION IDENTIFICATION : Tool Builder's MAnual

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/COTC
Mr. Robert L. Kaminski
Griffiss AFB, NY 13441-5700

AV 587-2925, COM: 315-330-2925

TITLE: RADCLAM - Radar Clutter and Multipath Simulation Program

DEVELOPER: RADC/EECT

STATUS: Operational

PURPOSE: To predict the real-time clutter power a radar will detect in a given terrain environment.

GENERAL DESCRIPTION: A computer program was developed to determine the amount of specular and diffuse multipath power reaching a monopulse receiver from a pulsed beacon and the associated boresight point error. Terrain inhomogeneities and multiple specular reflection points are included in the program.

The characteristics of electromagnetic signals scattered from rough terrain include contributions from clutter return and multipath return. These two aspects can be described by the theory of scattering from rough surfaces if properties of the terrain such as probability density function (PDF) for the surface height distribution, the covariance matrix, R, the variance in surface height, O, and the complex dielectric constant characterizing the surface are known. The numerous theoretical models of electromagnetic wave scattering from rough surfaces all relate the normalized cross section of terrain to the foregoing parameters characterizing the rough surface.

In this program the physical parameters of the rough surface are obtained from digitized terrain maps (furnished by the Electromagnetic Compatibility Analysis Center, ECAC, and the Defense Mapping Agency, DMA). Estimation theory is employed to specify the corresponding statistical parameters. A hypothesis testing procedure determines the PDF for the surface heights.

INPUT: Terrain data base as processed by ECAC computer programs, complex dielectric constants of terrain polarization of waves, wave frequency, height of receiver, trajectory of transmitter.

OUTPUT: Printout and plots.

MODEL LIMITATIONS: Two (2) scales of surface roughness

HARDWARE:

TYPE OF COMPUTER : CDC 6600, CYBER 750, CYBER 860
OPERATING SYSTEM : N/A
MINIMUM STORAGE : 80K
PERIPHERALS : Calcomp Plotter

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN
DOCUMENTATION IDENTIFICATION : RADC-TR-80-9, RADC-TR-80-300, RADC-TR-80-289

OPERATION: Batch or interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/EEC
Dr. R. Papa
Hanscom AFB, NY 01731

AV 478-3735, COM: 617-861-3735

TITLE: RADC RCS - RADC Radar Cross Section Simulation

DEVELOPER: Syracuse Research Corporation

STATUS: Fully Operational. Capability being extended.

PURPOSE: The code is used to predict cross sections of radar targets for radar system performance evaluations and signal processing studies.

GENERAL DESCRIPTION: RADCRCS is a deterministic modeling approach to predict radar cross sections of objects composed of generalized polyellipsoids and flat plat surfaces using the high frequency approximation techniques consisting of physical optics, the physical theory of diffraction with the equivalent current technique. The model is currently being extended to include hybrid methods which will contain the moment method technique. Predictions are performed for narrowband as well as wideband radar waveforms.

INPUT: Radar targets are generated using a computer aided modeling program called SCAMP. Other inputs consist of radar parameters such as center frequency, polarization, illumination geometry and radar waveform bandwidth.

OUTPUT: Outputs consist of CRT displays including narrowband RCS versus target aspect angle, range time intensity (RTI) plots of RCS versus slant range along the target and range-doppler images.

MODEL LIMITATIONS: The model is currently limited to monostatic scattering predictions from perfectly conducting objects with large body to wavelength ratios. The model is being extended to perform bistatic radar cross section predictions as well as predictions from nonmetallic surfaces.

HARDWARE:

TYPE OF COMPUTER : VAX 11/780
OPERATING SYSTEM : VMS 4.1
MINIMUM STORAGE : 12,000 blocks
PERIPHERALS : CRT display

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN
DOCUMENTATION IDENTIFICATION : User's Manual, Program Maintenance Manual
DOCUMENTATION AVAILABILITY : RADC/OCTM

OPERATION: Batch or Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/OCTM
Mr. James H. Michels
Griffiss AFB, NY 13441-5700

AV 587-4432, COM: 315-330-4432

TITLE: RADSIM - Radar Simulator

DEVELOPER: RADC/OCSA

STATUS: Operational

PURPOSE/GENERAL DESCRIPTION: This model simulates waveforms and their interaction with chaff, targets, propagation effects and clutter.

INPUT: Waveform parameters, digital filter parameters, jammers, signal processing parameters.

OUTPUT: Computer printouts, three dimensional ambiguity plots, voltage and power plots.

MODEL LIMITATIONS: Fast Fourier Transform size of 512 by 512

HARDWARE:

TYPE OF COMPUTER : VAX 11/780
OPERATING SYSTEM : GCOS
MINIMUM STORAGE : 1.9 million words
PERIPHERALS : Tektronix 4014 hooked to a HP-9820

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN
DOCUMENTATION IDENTIFICATION : User's Manual, Program Maintenance Manual

OPERATION: Batch and Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/OCTM
Mr. Stanley Borek
Griffiss AFB, NY 13441-5700

AV 587-4431, COM: 315-330-4431

RADC/OCSA
Mr. John C. Cleary
Griffiss AFB, NY 13441-5700

AV 587-3573, COM: 315-330-3573

TITLE: RAMP - RADC Automated Reliability and Maintainability Package

DEVELOPER: RADC/RBET

STATUS: On-going Expansion/Revision to keep pace with MIL-HDBK-217 revisions and to add additional computer RM modeling capabilities.

PURPOSE/GENERAL DESCRIPTION: The RAMP has been developed to interface a number of computer programs (ORACLE, OSAP, OTAP, CAMP and DTSTP) to provide a structured approach to electronic equipment/system reliability, maintainability and availability analysis.

The "RADC Optimized Reliability and Life Estimator" (ORACLE) performs electronic equipment/system reliability predictions in accordance with MIL-HDBK-217 "Reliability Prediction of Electronic Equipment". RAMP has been designed such that ORACLE interfaces with "ORACLE Stress Analysis Program" (OSAP) and "ORACLE Thermal Analysis Program" (OTAP) to determine electrical and thermal piece part stresses required in performing reliability predictions. The outputs of ORACLE are then utilized by the "Computer Aided Maintainability Program" (CAMP) as a basis for mean time to repair calculations. The primary outputs of RAMP and ORACLE are utilized by a submodule of ORACLE, "Reliability, Maintainability, Availability Analysis Tradeoff Tool" (RMA2T2) in order to evaluate redundant or distributed system availability or readiness. The Derivative Truncated Sequential Test Plan (DTSTP) is a stand alone reliability demonstration test analysis/synthesis program providing tradeoffs among consumer risk, producer risk and expected test time.

Access to RAMP is made available to DOD agencies and their contractors as Government Furnished Property (GFP) through a Budget Estimation Agreement (BEA) with RADC/RBET, Griffiss AFB, NY.

INPUT: Piece part environment, electrical and thermal stresses, level of indenture description of the equipment/system, replaceable unit time to repair, etc...

OUTPUT: Piece part failure rates; module/board failure rates and mean time to failure; equipment/system failure rates, mean time to failure, availability, mean time to repair, consumers/producers risks, expected tests times, etc...

MODEL LIMITATIONS: In some cases, for some of the programs, the user must input the data manually, rather than the program itself reading the data from a database, which also occurs in some of the programs.

HARDWARE: Honeywell Multics Operating System. (ORACLE is also operational on the DEC-20 Operating System)

SOFTWARE:
PROGRAMMING LANGUAGE : FORTRAN IV
DOCUMENTATION IDENTIFICATION : User's Manual for each program.

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified. Access limited to US Government agencies and their contractors.

POINT OF CONTACT: RADC/RBET
Mr. George W. Lyne/Ms. Florence Winter
Griffiss AFB, NY 13441-5700

AV 587-3069, COM: 315-330-3069

TITLE: RNET - Radar Network

DEVELOPER: Decision-Science Applications, Inc.

STATUS: RNET is not currently working due to a language problem between the FORTRAN IV compiler it was developed with and the current OC Surveillance Lab FORTRAN IV Compiler. This is being resolved by the project manager.

PURPOSE: Analysis of Tactical Sensor Networks to support evaluation of radar control algorithms.

GENERAL DESCRIPTION: One-sided, deterministic, time step, LAND/AIR. Faster than real-time.

INPUT: Radar and communications parameters and aircraft cross section and flight dynamic parameters.

OUTPUT: Graphics on the Tektronix 4110, plus hard copies of all displays and raw data.

MODEL LIMITATIONS: 100 aircraft, 20 radars, no geography.

HARDWARE:

TYPE OF COMPUTER	:	VAX 11/780
OPERATING SYSTEM	:	VMS
MINIMUM STORAGE	:	256K
PERIPHERALS	:	Tektronix 4014 or equivalent

SOFTWARE:

PROGRAMMING LANGUAGE	:	FORTRAN
DOCUMENTATION IDENTIFICATION	:	RNET User's Manual

OPERATION: Interactive, real-time.

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/OCDS
Capt. Fred R. Ahrens
Griffiss AFB, NY 13441-5700

AV 587-4441, COM: 315-330-4441

TITLE: RTD for FTS - Reliability, Testability and Design for Fault Tolerant Systems

DEVELOPER: SoHar, Inc.

STATUS: Technical Report, RADC-TR-84-57 documents study results

PURPOSE: Analysis of design options and requirements for fault tolerant systems. The technical report describes techniques for realizing the potential of distributed, fault tolerant systems to achieve high reliability and availability.

GENERAL DESCRIPTION: The technical report identifies methods for evaluating system reliability, describes design options and testability design options for fault tolerant distributed systems and provides guidance and checklists for the formulations of requirements for reliability and testability.

The report is intended for USAF personnel who generate requirements for distributed C3I systems, direct their development and conduct the evaluation of the system design.

INPUT: System mission requirements.

OUTPUT: Requirements, tradeoffs and design options can be defined.

MODEL LIMITATIONS: Exists only as written guidance in a technical report.

HARDWARE:

TYPE OF COMPUTER : N/A
OPERATING SYSTEM : N/A
MINIMUM STORAGE : N/A
PERIPHERALS : N/A

SOFTWARE:

PROGRAMMING LANGUAGE : N/A
DOCUMENTATION IDENTIFICATION : N/A

OPERATION: N/A

SECURITY CLASSIFICATION: Unclassified. Distribution limited to US Government agencies and their contractors.

POINT OF CONTACT: RADC/RBET
Ms. H. Dussault
Griffiss AFB, NY 13441-5700

AV 587-2951, COM: 315-330-2951

TITLE: SATCOM - An Adaptive Satellite Communications Computer Program

DEVELOPER: Syracuse Research Corporation (SRC)

STATUS: Operational

PURPOSE: Analyzes various adaptive satellite communications architectures against realistic jammer scenarios.

GENERAL DESCRIPTION: This is a flexible adaptive computer analysis model that has the ability to produce both conventional antenna patterns and adapted freeze patterns. The model can compute Signal-to-Background Ratio Improvement (SBRI) and Signal-to-Noise Ratio Degridation (SNRD) performance measures as a function of both signal location and bandwidth. This model is used to evaluate both fully-adaptive, planar, phased array and fully-adaptive Multiple Beam Antenna (MBA) communications systems.

INPUT: User signal location and parameters, parameters for antenna under test and jamming signal parameters.

OUTPUT: Computer generated plots, printouts of several system parameters (raw data), Signal-to-Noise Ratio Degridation (SNRD) data relative to changing jammer scenarios.

MODEL LIMITATIONS: 64 array elements, one (1) user signal, 63 jammer signals.

HARDWARE:

TYPE OF COMPUTER : Vax 11/780
OPERATING SYSTEM : Multics
MINIMUM STORAGE : 30K bytes
PERIPHERALS : Graphics terminal

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN
DOCUMENTATION IDENTIFICATION : User Guide RADC Technical Report 882-222 available to US Government agencies.

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCCR
Mr. Bill Cook or Lt. Kaldenbach
Griffiss AFB, NY 13441-5700

AV 587-3091, COM: 315-330-3091

TITLE: SATSIM - An Adaptive Satellite Communications Simulation Computer Program

DEVELOPER: Syracuse Research Corporation (SRC)

STATUS: Operational

PURPOSE: Simulate performance of various adaptive satellite communications system architectures against realistic pulsed jammer scenarios.

GENERAL DESCRIPTION: This is a fully interactive adaptive satellite antenna simulation that allows the user to enter a variety of input or control parameters and generate several performance measures. The program will generate adapted and unadapted antenna pattern plots, both in angle and frequency, and Signal-to-Noise Ratio Degridation (SNRD) plots on a sample by sample basis. The simulation allows the user to select a predetermined array type from a library or to manually enter a unique array configuration. The user can also employ predetermined jammer locations and characteristics or manually enter unique jammer parameters.

INPUT: Array parameters, user signal parameters and jammer parameters.

OUTPUT: Computer generated plots of scenario, computer generated plots of output parameters including SNRD (Signal-to-Noise Ratio Degridation) and adaptive weights on a sample by sample basis.

MODEL LIMITATIONS: 64 array elements, one (1) user signal, 63 jammer signals.

HARDWARE:

TYPE OF COMPUTER : VAX 11/780
OPERATING SYSTEM : MULTICS
MINIMUM STORAGE : 30K bytes
PERIPHERALS : Graphics Terminal

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN
DOCUMENTATION IDENTIFICATION : User Guide Syracuse Research Corporation Technical Report #83-1607 available to US Government agencies.

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCCR
Mr. Bill Cook or Lt. Kaldenbach
Griffiss AFB, NY 13441-5700

AV 587-3091, COM: 315-330-3091

TITLE: SBRCOV - Spaced Based Radar Coverage

DEVELOPER: RADC/OCSA

STATUS: Operational

PURPOSE/DESCRIPTION: A computer model was developed to determine the detection coverage of targets from a spaced based radar. The coverage is plotted on a mapof the world. The software for plotting on the map of the world is separate and can be used for other applications.

INPUT: Number of orbits, orbital parameters, map parameters, number targets and locations.

OUTPUT: Target tracks and detection on a global map.

MODEL LIMITATIONS: Ten (10) targets and sixty (60) satellites.

HARDWARE:

TYPE OF COMPUTER : VAX 11/780
OPERATING SYSTEM : VMS 3.3
MINIMUM STORAGE : 2.8 million words
PERIPHERALS : Tektronix 4014 terminal and Tektronix 4631 hardcopier.

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN
DOCUMENTATION IDENTIFICATION : N/A

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/OCSA
Mr. John C. Cleary
Griffiss AFB, NY 13441-5700

AV 587-3573, COM: 315-330-3573

TITLE: SEMRAD - Spectral Estimation Methods in Radar Detection Applications

DEVELOPER: Motorola, Inc.

STATUS: Operational

PURPOSE: The code is used to analyze moving target detection performance via Monte Carlo Analysis for five selected spectral estimation methods.

GENERAL DESCRIPTION: SEMRAD is designed for the purpose of statistically evaluating the relative moving target detection performance of a number of spectral estimation methods whose algorithm implementations are mechanized in 16 bit block floating point arithmetic. The operational scenario consists of an airborne surveillance radar which processes signals assumed to be from a given range cell in an environment containing clutter, residual interference and thermal noise.

INPUT: The program contains two menus for input parameters. The first is the radar signal generation parameter menu and contains those parameters describing the radar system, operational scenario, noise, clutter chaff and target. The second menu controls the input parameters to the signal processing stage of the program.

OUTPUT: The program provides two essential outputs: The statistical spectral analysis of the signals with and without targets and the detection probability profile. The outputs are achievable through two stages of processing called threshold generation and detection.

MODEL LIMITATIONS: The model is currently limited to processing data from a single range cell and currently contains five spectral estimation methods consisting of:

a. Modified Periodgram Method
b. Least Squares Method
c. Maximum Entropy Method
d. Combined Autoregressive Blackman-Tukey Method
e. Combined Likelihood Adaptive Doppler Filter Bank Method

The specific algorithms simulated and emulated (in fixed bit arithmetic) consist of:

a. Fast Fourier Transform
b. Batch Covariance Relaxation
c. Weighted Burg-Levinson
d. Autoregressive Blackman-Tukey
e. Burg-Levinson Adaptive Doppler Filter Bank

HARDWARE:

TYPE OF COMPUTER	:	VAX 11/780
OPERATING SYSTEM	:	VMS
MINIMUM STORAGE	:	3000 blocks
PERIPHERALS	:	CRT display

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN '77
DOCUMENTATION IDENTIFICATION : User's Manual, Program Test Plan, Test Analysis Report, Program Maintenance Manual, Program Specification

OPERATION: Batch or Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/OCTM
Mr. James Michels
Griffiss AFB, NY 13441-5700

AV 587-4432, COM: 315-330-4432

TITLE: SIM DRIVER - Simulation Driver Integration

DEVELOPER: PAR Government Systems Corporation

STATUS: Expected Delivery Date 21 Jan 86

PURPOSE: To integrate the Advanced Sensor Exploitation (ASE) Scenario Generator/Dynamic Ground Target Simulator (DGTS) System with the Tactical Air Surveillance Model II (TACOM II) to provide an operational environment containing the air/ground battle.

GENERAL DESCRIPTION: (Two sided, Mixed deterministic and stochastic, Either time step or event step, Air/ground forces, High resolution).

The DGTS system controls the execution of a particular simulation model, such as the Simulation Driver Integration model, in either a time step mode or an event step mode, depending on command qualifiers. Scenario information, such as vehicle locations, aircraft locations and radio emission descriptions, are recorded in a scenario archive file and/or transmitted using DECnet to other processes (called scenario subscribers) for immediate processing.

The Simulation Driver Integration model supports the generation of scenarios containing both Red and Blue ground and air forces. Individual vehicles and aircraft are represented, with their locations updated at intervals ranging from five (5) seconds to one (1) minute. Vehicles are moved either along roads or across country, and can assume a variety of march and deployment patterns. Aircraft can take off, land, orbit and fly along terrain-following paths through specified waypoints. Individual jammers, radars, radios, sensors, and weapons on each platform (vehicle or aircraft) are modelled. Platforms are organized into hierarchical units, up to division, corps and army level. A command and control module produces realistic patterns of behavior (communications, attacks, etc...) automatically in response to various scenario events. Most processes are simulated deterministically, but random numbers are used in resolving combat, and in generating some radio, radar and jammer emissions.

The ratio of real time to scenario time varies depending on the size (number of entities) in the scenario, the frequency with which various types of scenario entities are updated, and the characteristics of the processor on which the model is executed. On a VAX 11/780 with 4-8 megabytes of memory, division size scenarios involving approximately 4000 entities updated every thirty (30) seconds can be generated in real time.

INPUT: Required databases include cartographic (terrain elevation and road network) databases describing the battlefield, the Red and Blue scenario forces (either of which may be empty), Red and Blue equipment characteristics, Red and Blue hierarchical unit structures, Red and Blue communication network structures, and Red and Blue march and deployment pattern templates. In addition, a scenario orders file specifies the initial locations, postures, routes or flight paths, and speeds of the units in the scenario, as well as any scenario events which must be specifically scheduled in advance.

OUTPUT: One of the scenario subscriber processes, the DGTS Scenario Monitor, provides a dynamic color display of the scenario as it is generated. It also allows interactive control of the scenario by allowing events to be interactively scheduled. Streams of scenario messages can also be sent to other scenario subscriber processes. In addition, several types of formatted listings can be produced, tracing scenario events and providing summaries of scenario generation performance.

MODEL LIMITATIONS: Representations of radios, radars, jammers, sensors and weapons are fairly simple. Ground force combat is not included. Logistics are not simulated except for aircraft fuel and weapon ammunition. The rules which represent the reactions of command and control nodes to scenario events are very limited in terms of their ability to handle unforseen combinations of events. Cartographic data is limited to terrain elevation and road network information. Weather is represented only in terms of general conditions over the entire simulated battlefield area. The generation of very large scale or long duration scenarios can be extremely resource intensive on smaller systems.

HARDWARE:

TYPE OF COMPUTER : DEC VAX 11/780
OPERATING SYSTEM : VAX/VMS
MINIMUM STORAGE : Minimum of four (4) megabytes of physical memory, additional physical memory significantly improves scenario generation performance.
PERIPHERALS : Minimum of fifty (50) megabytes of disk space is generally required for storing cartographic and military force databases as well as the system software, models, and other miscellaneous files. A Ramtek 9400 series color display system (9400, 9600, or 9465) is required to support the DGTS Scenario Monitor and some of the database preparation tools which are graphically oriented.

SOFTWARE:

PROGRAMMING LANGUAGE : Primarily VAX-11 Pascal with a few procedures written in VAX-11 MACRO Assembler language.
DOCUMENTATION IDENTIFICATION : Multivolume User's Manual, which addresses the development of simulation models using the DGTS system, the preparation of cartographic and military force databases and the generation of scenarios using existing models and databases. Program Maintenance Manual covering the DGTS system and the available simulation models which are also available.

OPERATION: The software system is interactive, using a set of commands based on VAX/VMS command language syntax. Some operations, such as the formatting of large databases or the unattended generation of large scenarios, can be executed as batch jobs using VAX/VMS command procedures.

SECURITY CLASSIFICATION: All system and model software in unclassified. Most existing databases are unclassified. A few existing Red military force databases are classified.

POINT OF CONTACT: RADC/COTD
Ms. Mary L. Denz
Griffiss AFB, NY 13441-5700

AV 587-3623, COM: 315-330-3623

TITLE: SRS - Speech Recognition Simulation

DEVELOPER: RADC/IRAA

STATUS: Operational

PURPOSE: This simulation is designed to provide in-house facility for performing speech recognition experiments. It also permits altering recognition algorithms for exploration of recognition schemes.

GENERAL DESCRIPTION: This simulation is a complement of software modules and custom programs to perform recognition.

INPUT: Pre-stored, digital speech samples.

OUTPUT: Recognition scores (cumulative), confusion matrices and statistics.

MODEL LIMITATIONS: N/A

HARDWARE:

TYPE OF COMPUTER : PDP 11/70; 11/45
OPERATING SYSTEM : RSX-11M
MINIMUM STORAGE : N/A
PERIPHERALS : Standard A/D, D/A; Interactive graphics; Line printer.

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN 77

OPERATION: N/A

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/IRAA
Dr. James D. Mosko
Griffiss AFB, NY 13441-5700

AV 587-4024, COM: 315-330-4024

TITLE: TAC Controller

DEVELOPER: Westinghouse Corporation

STATUS: Operational

PURPOSE: A digital computer simulation of complete C3 system operating in user-specified battle scenario.

GENERAL DESCRIPTION: The TAC Controller is a large scale software simulation model directed towards providing an assessment of meaningful mass air raids as applied to the TAC 407L/412/E-3A configuration missions and vulnerability as developed in USAF. Predefined threat scenarios as they affect air defense, system detection, capability and ECCM are exercisable options. Input parameters consist of friendly/hostile force structures, radars, air bases, E-3A, AAA, SAMS communication network data and the ECM/ECCM environments. Output parameters consist of system survivability, network communication data, radar track statistics, track handover data, missile site data, resource statistics and second day battle resources and allocation data files.

To expedite performance assessment of an operational scenario(s), the Tektronix (TK) 4054 interactive graphic computer facility model provides a user interactive operation capability to conduct detailed analyses from a system to subsystem level on an interactive graphics display. User friendly, the graphics routines provide insight for the system analyst to determine measures of effectiveness (MOE's), system requirements and recommend solutions.

The TAC Controller, executable on the RADC/HI 6180, is supported (on-Center) by FORTRAN, under the GCOS operating system. The TK 4054, equipped with Option 30 interactive board, is supported by Extended-Basic Plots 10 and 50. The graphics display is capable of interfacing with the TAC Controller post-processed data, to provide:

a. flight paths of friendly/hostile aircraft;
b. radar detection coverage diagrams for clear and jamming environments;
c. time snapshots battle statistics such as: number and spatial density distribution of a/c, number engaged, destroyed, reached objective(s).

INPUT: Components of major systems (407L, 485L, 412L and E-3A) are communication FACP's, CRP, CRC,SAMS, and ECM tactics.

OUTPUT: C3 vulnerability, enhanced survivability, intercept efficiency red tactics and system responses.

MODEL LIMITATIONS: None

HARDWARE:

TYPE OF COMPUTER	:	HI 6180
OPERATING SYSTEM	:	GCOS
MINIMUM STORAGE	:	89K bytes
PERIPHERALS	:	N/A

SOFTWARE:
PROGRAMMING LANGUAGE : FORTRAN IV
DOCUMENTATION IDENTIFICATION : User's Manual, Documented Sample Cases

OPERATION: N/A

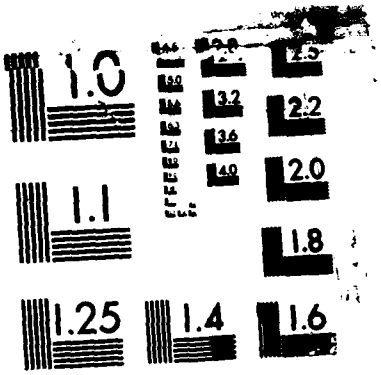
SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/OCTM
Mr. Dan Gentile
Griffiss AFB, NY 13441-5700

AV 587-4443, COM: 315-330-4443

AD-A168 344 SURVEY OF MODELS/SIMULATIONS AT RADC (ROME AIR DEVELOPMENT CENTER) VOLUME 3(U) ROME AIR DEVELOPMENT CENTER GRIFFISS AFB NY M L DENZ MAR 86 RADC-TR-86-9 2/2

UNCLASSIFIED F/G 17/2 NL



TITLE: TACOM II - Tactical Communication Simulation Model II

DEVELOPER: Hazeltine Corp., original version. Modification performed in-house.

STATUS: Operational

PURPOSE: Analysis of communication system effectiveness in a tactical environment and mission effectiveness as a function of communication link performance.

GENERAL DESCRIPTION: The TACOM II model is a free play, dynamic, event keyed model of the tactical ultra high frequency (UHF) communication air/air, air/ground/air environment. The model employs spread spectrum modem and adaptive array antenna signal processors on a tactical aircraft in a dynamic tactical electronic warfare environment. Unit types which are modeled include friendly and hostile fighters, close air support aircraft, surface to air missiles, jammers, forward observers, forward air controllers, tactical air control party, command and reconnaissance posts and tanks. The TACOM II simulation models factors such as: ground multipath, obstacles, diffraction over obstacles, airframe scattering, signal propagation losses, radar, and visual sensors (the pilot's field of vision). The graphic outputs of the model are used to evaluate system performance in a given tactical environment. These include, areas of usable communication throughout the aircraft flight profiles, adaptive antenna pattern plots, jammer to signal ratio (J/S) plots of the effectiveness of the adaptive antenna with respect to an omni antenna along the flight profile. Other ways of evaluating system effectiveness are the number of enemy targets destroyed and the number of returning friendly aircraft.

INPUT: A close air support or air interdiction scenario including TACP, CRP, FAC, SAM, tanks, A-10 aircraft, F-15 aircraft, forward observers, CRC and air to air missiles.

OUTPUT: Computer printouts, plots, raw data, statistically analyzed data.

MODEL LIMITATIONS: Maximum number of units is forty-one (41). The frequency range of communication systems is VHF to UHF.

HARDWARE:

TYPE OF COMPUTER : Honeywell 6180
OPERATING SYSTEM : MULTICS
MINIMUM STORAGE : 20K lines of source code
PERIPHERALS : 4014 Tektronix Terminal

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN IV
DOCUMENTATION IDENTIFICATION : Computer Operational Manual For Tactical Communication Model II (RADC-TR-80-264), Tactical Communications System Analysis II (RADC-TR-80-321) and TACOM II Simulation Program Modifications (RADC-TR-84-3)

OPERATION: Real time and/or interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCCD
Mr. Alan Akins
Griffiss AFB, NY 13441-5700

AV 587-3225, COM: 315-330-3225

TITLE: TASRAN II - Enhanced Tactical Air Surveillance Radar Netting

DEVELOPER: General Research Corporation

STATUS: Operational

PURPOSE: Evaluation of netted tactical air surveillance configurations with arbitrary numbers and types of radars, aircraft and communications links.

GENERAL DESCRIPTION: TASRAN II is a computer simulation for evaluating netted tactical air surveillance systems. Both E3-A and the Advanced Airborne Surveillance Radar Systems, as well as the traditional ground based radars, can be modeled by the simulation. The system acquires and tracks hostile radar in a realistic threat environment. The threat environment can include aircraft, jammers, and ground targets. Acting as an emulator, TASRAN II will accept actual radar measurements, or radar track messages, in standard format, and process them along with the simulated data.

The data processing functions of radar detection, tracking initiation, correlation and automatic tracking are actually performed on the simulated radar returns. Site-to-site communications can be modeled at different levels of complexity, from simple message routing to detailed calculations of propagation and jamming degradation. Output can be in either tabular or an interactive graphical format.

Currently, a contractual effort is under way to combine TASRAN with the DGTS simulation. This will enable the user to develop a more accurate scenario model for use with the TASRAN radar for use in clutter calculations netting capabilities. Enhancements include detailed ground terrain and friendly aircraft returns radar.

INPUT: Radars, radar data processors, control module data processors, scenario communication network.

OUTPUT: Radar track data, radar data files, system data files, specific radar network configurations.

MODEL LIMITATIONS: None.

HARDWARE:

TYPE OF COMPUTER	:	DEC VAX 11/780
OPERATING SYSTEM	:	VAX/VMS
MINIMUM STORAGE	:	1500 words
PERIPHERALS	:	Tektronix 40XX series or better terminal

SOFTWARE:

PROGRAMMING LANGUAGE : CIFTRAN/SIMULTRAN/FORTRAN
DOCUMENTATION IDENTIFICATION : Technical Memorandum, User's Manual Programmer's Manual, Documented Sample Cases, Test Reports.

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/OCTM
Mr. Dan Gentile
Griffiss AFB, NY 13441-5700

AV 587-4433, COM: 315-330-4433

TITLE: TELMOD - Telemetry Modeling Capability

DEVELOPER: LTV Corporation, Dallas, TX

STATUS: Operational

PURPOSE: TELMOD supports the development of non-refined Ballistic and Aerodynamic missile modeling.

GENERAL DESCRIPTION: TELMOD is models implemented in FORTRAN. The Ballistic Missile includes a multi-stage booster system, post boost vehicle and a re-entry vehicle. Each vehicle is constructed of subsystems which can be executed independently or together. A "Phasing" feature allows subsystems to be reconfigured during execution when specific conditions are met. The user interface employs interactive block diagram graphics.

INPUT: Data is input directly by the user or by (specific format) external files via a "Waveform Input" capability.

OUTPUT: After execution, system or subsystem outputs can be either plotted or calculated.

MODEL LIMITATIONS: Since TELMOD provides coarse missile representations for a broad class of vehicles, limitations exist when attempting to model highly specific or refined features.

HARDWARE:

TYPE OF COMPUTER	:	VAX 11/750
OPERATING SYSTEM	:	N/A
MINIMUM STORAGE	:	N/A
PERIPHERALS	:	TEK 4014

SOFTWARE:

PROGRAMMING LANGUAGE : FORTRAN
DOCUMENTATION IDENTIFICATION : User's Manual, Final Report, S/W Documentation, Maintenance Manual.

OPERATION: Batch Processing

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/IRAE
Lt. Steve Farr
Griffiss AFB, NY 13441-5700

AV 587-7152, COM: 315-330-7152

TITLE: Traffic Simulator (replaces TSE Traffic Simulator for Experimental Integrated Satellite Network (EISN))

DEVELOPER: Western Union

STATUS: In-Test (A/O Nov 83)

PURPOSE: The Traffic Simulator was designed as a generalized means for generating, in real time, communications events such as telephone calls, telex and host transmissions. As delivered it is equipped with the required electrical and protocol interfaces so that it ties directly into the Integrated Node located in the Communications Division Switching Laboratory. It is intended to provide the means to experiment with multi-user systems where it is desirable to emulate many independent sources which are driving some communications device under test. It generates these communications events with a statistical distribution determined by the user. It produces statistics as the user sees the system, i.e. in terms of delays, traffic throughput, etc.

GENERAL DESCRIPTION: The Traffic Simulator is made up of two major hardware subsystems: a Host PDP 11/44 and several UMC Z80 Microprocessors. The Host serves several functions and is the heart of the simulator. It interacts with the user defining: the line configuration, the call/message/packet generation statistics, desired data, test run length and similar test definition functions. It will initiate the test at the time requested and for the length specified. At the times calculated, based upon the initial inputs, it will generate "tickets" that completely determine a call, its length, etc., which are then passed to the microprocessors which have the required interface software previously loaded by the host processor. The microprocessors act as the "user" and for all practical purposes it is a real user to the system under test.

INPUT: Operator interface is accomplished via a VT 100 terminal.

OUTPUT: System is presently configured to operate full duplex with the following interfaces:

a. DCS AUTODIN MODES I and II (75-9600 baud)
b. HDLC
c. X.25
d. SDLC
e. ADCCP
f. EISN ADCCP
g. BISYNC

(2-7 above can operate 1200-64000 baud)

h. CVSD Voice at 19.2 or 38.4 BPS (unique signalling used)

MODEL LIMITATIONS: Comes equipped with twelve UMC Z80s which can be configured as desired.

HARDWARE:

TYPE OF COMPUTER : PDP 11/44
OPERATING SYSTEM : RSX-11M
MINIMUM STORAGE : 256K bytes

PERIPHERALS : Line printer, disk storage, tape drives, cassette drive, operator terminal

SOFTWARE:
PROGRAMMING LANGUAGE : FORTRAN, Z80 Assembly Language
DOCUMENTATION IDENTIFICATION : User's Manual, Operator's Manual Design Specifications, Final Technical Report

OPERATION: Via the VT 100 operator's terminal

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCLD
Mr. John Salerno
Griffiss AFB, NY 13441-5700

AV 587-7751, COM: 315-330-7751

TITLE: TROPO ECM Simulator - Troposcatter Electronic Counter Measures

DEVELOPER: Signatron, Inc.

STATUS: Operational

PURPOSE: To provide jamming sources, combined with signals from the tropo simulator, so to create an ECM environment for TE of tropo radio equipment at 70 MHz IF, and/or 4.4-5.0 GHz RF.

GENERAL DESCRIPTION: The Tropo Electronic Counter Measures (ECM) Simulator operates in conjunction with a Troposcatter channel simulator to simulate in a laboratory environment Troposcatter communication with jamming. The jamming source model of the Line-of-Sight (LOS) ECM Simulator may be used to provide an additional direction of jamming. The Tropo ECM Simulator creates an ECM environment for test and evaluation of tropo radio equipment at a 70 MHz intermediate frequency (IF) and receivers at a 4.4-5.0 GHz radio frequency (RF).

Four major components make up the Tropo ECM Simulator. First, there is the Dual Tropo Jammer Source which generates IF signals to simulate a jammer broadcasting to a Troposcatter receiver. The Jammer Delay-Combiner is the second major section. This section combines the IF communications signals with appropriately delayed IF jammer signals for simulation of off-axis jamming. The third major section is the IF/RF interface which converts the previously mentioned combined IF signals to RF for testing of receiver front ends. The fourth major section is the power supply section.

INPUT: Analog in.

OUTPUT: Analog out.

MODEL LIMITATIONS:

a. IF: 70 MHz
b. BW: +/- 12.5 MHz
c. RF: 4.4-5.0 GHz
d. Only one jammer type can be used at a time, unless the jamming source module of the LOS ECM Simulator is used to provide an additional direction of jamming.
e. Given three jamming source modules a total of three directions of jamming can be accommodated.

HARDWARE:

TYPE OF COMPUTER : Unique dedicated hardware design
OPERATING SYSTEM : N/A
MINIMUM STORAGE : N/A
PERIPHERALS : N/A

SOFTWARE:

PROGRAMMING LANGUAGE : N/A
DOCUMENTATION IDENTIFICATION : Operating Maintenance Manual, Technical Report.

OPERATION: Real-time, direct connection to equipment undergoing test.

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCLF
Mr. Peter Leong
Griffiss AFB, NY 13441-5700

AV 587-4567, COM: 315-330-4567

TITLE: Troposcatter Channel Simulator

DEVELOPER: Signatron, Inc.

STATUS: Operational

PURPOSE: To provide synthetic medium simulation of the troposcatter channel for direct connection TE of tropo modems at IF of 70 MHz with 10 MHz BW. Up to eight (8) diversities can be provided.

GENERAL DESCRIPTION: The Troposcatter Channel Simulator was developed in 1973. It is a versatile laboratory quality instrument which will provide accurate and repeatable simulation of multipath effects typical of troposcatter communication links. The Troposcatter Channel Simulator is designed to be used between modem equipment operating at an intermediate frequency of 70 MHz and with a signal bandwidth of up to 10 MHz. It was updated to provide simulation of up to three (3) tandem links, input-output linearization for AM-like modems, correlations of diversity outputs and up to eight diversities. It is primarily used for test and evaluation of tropo modems/terminal equipment.

INPUT: Analog signals in.

OUTPUT: Analog signals out.

MODEL LIMITATIONS: Model: wide sense stationary uncorrelated scattering (Bello) model implemented as tapped delay line model. The maximum number of taps is 16 . Tap spacing is fixed at .1 usec.

HARDWARE:

TYPE OF COMPUTER : Unique dedicated hardware design
OPERATING SYSTEM : N/A
MINIMUM STORAGE : N/A
PERIPHERALS : N/A

SOFTWARE:

PROGRAMMING LANGUAGE : N/A
DOCUMENTATION IDENTIFICATION : Operating/Maintenance Manual with detailed schematics, Technical Report.

OPERATION: Real-time

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCLF
Mr. Peter Leong
Griffiss AFB, NY 13441-5700

AV 587-4567, COM: 315-330-4567

TITLE: UMOS - Universal Model for Orbital Simulation

DEVELOPER: RADC/IRAE(Matthew Antonik)

STATUS: Available Sep 85 for most functions

PURPOSE: UMOS provides manipulation for orbital data centralizing on coordinate transformation and future time prediction based on known position and velocity vectors.

GENERAL DESCRIPTION: UMOS utilizes analytic geomansy and matrix equations for coordinate transformations and mathematical methods developed by Newton, Kepler and Gibbs for calculating orbital characteristics.

INPUT: Using any or all of velocity and position vectors, and orbital parameters, the user describes the orbit of the target object. Future time for prediction will also be necessary.

OUTPUT: Output is chosen by the user to be a table of positions over a given time, a single future point, an orbital wire diagram or coordinates of another system.

MODEL LIMITATIONS: Accuracy of prediction decreases and time for evaluation increases as orbits approach parabolic trajectories. Some orbits will present mathematical anomolies in the iteration scheme.

HARDWARE:

TYPE OF COMPUTER	:	Tektronix 4054
OPERATING SYSTEM	:	N/A
MINIMUM STORAGE	:	8K
PERIPHERALS	:	One (1) disk drive

SOFTWARE:

PROGRAMMING LANGUAGE	:	BASIC
DOCUMENTATION IDENTIFICATION	:	N/A

OPERATION: Interactive

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/IRAE
Mr. Mark G. Alford
Griffiss AFB, NY 13441-5700

AV 587-7152, COM: 315-330-7152

TITLE: Wideband Line-of-Sight (LOS) Channel Simulator

DEVELOPER: CNR

STATUS: Operational

PURPOSE: TE of modems designed to operate over LOS (line-of-sight) channels, i.e. point-to-point microwave, satellite, UHF and microwave aircraft channels.

GENERAL DESCRIPTION: The Wideband Line-of-Sight (LOS) Channel Simulator is a means for evaluating wideband digital modems designed to operate over LOS channels. The types of LOS channels handled by the system include: airplane-airplane, ground-airplane, ground-ground and airplane-satellite. In addition, the simulator allows the the introduction of controlled amounts of nonlinearity, phase jitter and frequency offset. The simulator operates at selectable intermediate frequencies (IF) of 70, 300 or 700 MHz. Signal bandwidths up to 100 MHz may be accommodated at the two higher IF frequencies, while at 70 MHz, bandwidths up to 25 MHz may be accommodated.

INPUT: Nominal odBm, 50 ohms

OUTPUT: Nominal odBm, 50 ohms

MODEL LIMITATIONS: Simplex operation only

HARDWARE:

TYPE OF COMPUTER	:	PDP 11/40
OPERATING SYSTEM	:	RSX-11M
MINIMUM STORAGE	:	8K by 16 bit internal memory
PERIPHERALS	:	VT 50 CRT

SOFTWARE:

PROGRAMMING LANGUAGE	:	Assembly and FORTRAN
DOCUMENTATION IDENTIFICATION	:	Operator's Manual, Technical Report

OPERATION: Real time

SECURITY CLASSIFICATION: Unclassified

POINT OF CONTACT: RADC/DCLF
Mr. John Evanowsky
Griffiss AFB, NY 13441-5700

AV 587-4567, COM: 315-330-4567

APPENDIX I

QUESTIONNAIRE

DATA COLLECTION SHEET

TITLE: (Acronym followed by full name)

DEVELOPER: (Organization/Corporation which developed current version of the model)

STATUS: (State whether operational, under development, under validation or specify expected delivery date)

PURPOSE: (Analysis/training), (Manual/computerized/computer assisted), (General or limited war/politico-military/logistics/damage assessment)

(This section should contain a brief narrative covering the above, the role the model plays and the primary and secondary problem the model addressed)

GENERAL DESCRIPTION: (One/two sided), (Deterministic/stochastic/mixed), (Time step/ event store), (Land/air/sea/paramilitary/civilian/etc.)

(This section is a brief narrative covering the above, level of unit/personnel/equipment/target aggregation, level of exercise, ratio of game time to real time and primary solution techniques)

INPUT: (For example, scenario, weapons, characteristics, troop unit size, arrival dates)

OUTPUT: (Computer printout, plots, raw data, statistically analyzed data)

MODEL LIMITATIONS: (e.g., number of targets, no geography)

HARDWARE:

- Type computer:
- Operating system:
- Minimum storage:
- Peripheral equipment:

SOFTWARE:

- Programming language:
- Documentation identification:
- Documentation availability:

OPERATION: (Identify the type of operation required, i.e. batch, real time, and/or interactive)

SECURITY CLASSIFICATION: (Identify the security classification level of the model/simulation.

POINT OF CONTACT: (List organization, address, and telephone number from which additional information can be obtained. Office symbols where applicable should be included.)

MISSION
of
Rome Air Development Center

RADC plans and executes research, development, test and selected acquisition programs in support of Command, Control, Communications and Intelligence (C^3I) activities. Technical and engineering support within areas of competence is provided to ESD Program Offices (POs) and other ESD elements to perform effective acquisition of C^3I systems. The areas of technical competence include communications, command and control, battle management, information processing, surveillance sensors, intelligence data collection and handling, solid state sciences, electromagnetics, and propagation, and electronic, maintainability, and compatibility.

END

DTIC

7-86